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Railway Mechanical Engineer

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Motive Power Efficiency and Boiler Scale

There are many roads that could increase the service secured from locomotives by taking some measures to prevent the formation of scale in the boilers. It is surprising that more is not done to prevent the formation of scale or to remove scale already formed even in districts where the water carries a great deal of incrusting matter. The condition of the boiler is often the most important of the factors which determine when locomotives must be shopped for heavy repairs. There are but few defects of the machinery which cannot be remedied in the enginehouse, but when the boiler requires extensive repairs it is usually necessary to put the locomotive in the shop.

It is hardly necessary to say that anything that will increase the period during which locomotives can be kept in service is important at this time. Motive power is in great demand and railroad shops report a serious shortage of skilled labor. The prices of boiler sheets and boiler tubes are extremely high. The records of roads that have adopted the practice of fighting boiler scale show that there is a marked reduction in the amount of boiler work required and that the service secured from firebox sheets and tubes is increased. There is another advantage to be gained by such treatments. If the sheets and tubes are clean, they conduct heat much more readily than if the surfaces are covered with scale. At present, when the saving of fuel is of such great importance, the opportunity for conservation by this method should not be overlooked.

It requires but a comparatively slight investment to install an anti-scale forming system. The supervision required to keep it operating satisfactorily is likewise small. The advantages to be gained are great, particularly under the present circumstances, and roads that are troubled with bad water conditions should give thorough consideration to the results that can be secured by adopting a method of preventing scale.

Increased Supervision Necessary

Regardless of the number of men working in either the shops or engine houses, there is at this time a most decided demand for competent and adequate supervision. The labor turnover has been so great even among the old employees that unless the new men coming into the shops are carefully instructed, the work will not be properly done and a great deal of time will be wasted. In the past the railroads have had plenty of "railroad" mechanics to whom specific jobs could be intrusted with no more than passing supervision and inspection. These men were assigned to particular work and kept constantly on that work, becoming proficient in it. They had been with the railroads for a long time—in most cases they were brought up in railroad shops; but now the industries have taken a large number of these men away. Their places have been filled by the uninitiated—men who are unfamiliar with railroad shop practice. It is these men that must be educated to the peculiarities of railroad repair work. Adequate supervision is the answer. The railroad shops must have it and the railroads must make it worth while for experienced railroad mechanics to stay with them.

The depletion of the forces has not been restricted to the mechanics alone. Many foremen have been tempted away by better conditions and more pay. These men must be taken care of as well as the mechanics. Some roads have

done this admirably and have had little disturbance to their organization. Other roads have lost many able men. The need for locomotives and cars was never greater than it is at the present time. Every means must be taken to keep them in repair. The mechanical department officers should not allow their forces to become disorganized. The living conditions must be met. The only way to hold the men is to make the work attractive to them.

Ample Ash Pan Opening

An interesting illustration of the need of sufficient air opening in ash pans was brought out by W. L. Robinson recently at the New England Railroad Club. He told of a case where it was desired to burn high volatile coal in some new stoker locomotives, but that only one engineman was able to do it successfully, the others finding it necessary to use coal having lower volatile matter. This engineman would not give up his secret. By watching him carefully it was found that he opened the ash pan slide, permitting more air to get in under the grate. This circumstance clearly shows how important it is to have proper ash pan opening.

There are many locomotives operating today which are handicapped by this very thing. Not only is the capacity of the locomotive limited, but coal is wasted, the gases passing off through the stack unburned. The best accepted practice requires that the total free air opening in an ash pan be 14 per cent of the grate area. Where these openings are covered by netting, the restrictions caused by the netting must be considered. It is the customary practice to provide these openings at the sides. Investigations are being made, however, to determine whether or not part of the air might be admitted to the ash pan advantageously at the front and back. In any case it is essential that enough air be admitted and that the volume of the ash pan be sufficiently large.

Improved Locomotive Deliveries

In the article on the locomotive orders in 1917 in last month's *Railway Mechanical Engineer* the statement was made as to the locomotive situation that "the outlook both for deliveries and production in 1918 looks exceedingly favorable," and it was further added that "the supply field is confidently expecting a large buying movement." Although less than a month has passed since that time, these prophecies, if such they may be called, are already being borne out. In the month of January, to take new orders first, 197 locomotives were ordered, including 29 for export and 168 for domestic roads,—not a record breaking figure by any means, but a considerable increase over the totals for the months immediately preceding. Nearly all of the domestic orders were for eastern lines and the major part of them were large sized engines. The situation as to deliveries of locomotives now on order is improving from day to day. The American Locomotive Company has on its February schedule about 200 locomotives, nearly all of which are large units. The Richmond and Montreal plants are now being made over for locomotive instead of shell production, which will mean in the near future, a further increase of about 25 or 30 locomotives a month.

The Baldwin Locomotive Works is now approaching a capacity output of 100 large locomotives a week and with new facilities nearing completion and expected improvements in the labor and material situation, should soon reach that figure. The eastern roads will, of course, secure the benefit of the increases in output, Director-General McAdoo having ordered that all locomotives for domestic railroads produced in January, February and March, amounting to 150, 250 and 250 respectively, be turned over to specified eastern roads, regardless of who contracted for them. The swinging of 165 locomotives now in service from western to eastern roads; the putting in service on the rails here of 100 locomotives intended for the American forces in France; the contemplated conversion of 200 Russian locomotives, and the new deliveries will help the motive power situation tremendously. In short, the motive power officer can now see ahead of him the opportunity to overcome the serious shortage of motive power that is driving all railway men to distraction. The new orders, further, will guarantee that future production will be kept up. It was natural that there should have been few orders for new locomotives in the fall of last year when priority was given to Russian and other orders. Now that every possible step is being taken to increase the production of locomotives for domestic use, and a railway can look forward to receiving its locomotives before the war is over, increased orders for locomotives for domestic roads can confidently be expected. It is fortunate that at last extraordinary efforts are being taken to relieve a very bad condition.

Railroad Power Plants

Railroad power plants consume a large amount of fuel, but as a rule they receive very little notice. The fuel consumption of locomotives is watched closely to insure economy, but the consumption of the power plant is relatively small and for that reason escapes attention. On a number of roads the amount spent for fuel for power plants amounts to half a million dollars a year, and a considerable expenditure for supervision is justified if it will result in a reduction of this large item of expense.

It is surprising to note how many roads have retained at their shops the system of providing separate power plants for each building or department. This inevitably requires the services of a considerable number of men, making the cost of wages excessive. The equipment of such small plants is usually inefficient, radiation losses are high, combustion is poor and the handling of coal and ashes crude and uneconomical. With fuel so expensive and labor so hard to get, such conditions should not be allowed to exist. The investment required to replace small units with a single well-designed and well-equipped plant will yield big returns.

In centralized plants the most serious waste usually results from improper operation rather than from poor design. Engines and generators are ordinarily kept in good condition, but the boilers and their appurtenances, though even more important, are often neglected. In most plants the exhaust from the auxiliaries can be used to heat the feed water. If the water contains considerable amounts of impurities it should be treated. The factors effecting combustion should be given close attention. The draft should be suited for the kind of fuel used and should be strong enough to insure complete combustion. Where economizers are used special attention must be paid to the matter of securing sufficient draft. Boiler settings and stacks should be kept free from leaks.

In the distribution of power constant attention is necessary to prevent waste. A 1/16-in. hole in a steam line carrying 150-lb. pressure will waste 26 lb. of steam an hour, which is nearly a boiler horsepower. A hole of the same size in an air line carrying a pressure of 100 lb. will waste more than a horsepower. In electric circuits there is danger of power being wasted by keeping lights burning when they are not needed and by running shafting when none of the machines it drives is in use. There are countless other things that often result in inefficient operation in power plants, some of the most important being the practice of operating too many boilers at low capacity and failure to give proper attention to the removal of scale and soot from boilers.

Frequent and regular inspection with prompt attention to cleaning and repairs when needed will do a great deal toward

keeping the efficiency of the power plant at a high level, but inspection will not always show up the losses that occur, and for that reason it is advisable to run frequent tests, or better still, keep continuous records to determine whether the maximum economy is being secured from the plant. In a small plant elaborate apparatus is not required. Every powerhouse should keep a record of the water and coal consumption and the draft on the boilers and should have periodic analyses made of the coal and ash. Larger plants should be equipped with flow meters, temperature recorders and apparatus for making flue gas analysis.

Railroad power plants as a rule are given very little supervision. To operate a power plant successfully requires special training. Very few master mechanics or general foremen have sufficient knowledge of power plants to manage them efficiently. The best way to overcome this difficulty is to have a special organization to supervise the operation of all the power plants on the system. By having a special organization in charge of the power plants it is possible to insure that every plant will have expert supervision. It is by no means easy to secure competent engineers to operate power plants. If the plants are under the jurisdiction of the master mechanic or general foreman, the engineer has few opportunities to secure promotion. Where all the power plants are under one head the matter of advancement can be handled much more satisfactorily. This is one of the important advantages in having a special organization in charge of power plants.

High Capacity Hopper Cars

One feature in the design of the so-called 100-ton coal car, recently built by the Norfolk & Western, not brought out in the description of the car which appears elsewhere in this issue, is the remarkably light weight of the car in relation to the capacity. The cars as shown are nominally rated at 90 tons which provides a maximum carrying capacity with 10 per cent overload of practically 100 tons, and the light weight of the car is 60,000 lb. The ratio of revenue load to the gross weight of the loaded car is 77 per cent, a ratio which, so far as is known, has not successfully been exceeded. This is the more remarkable when it is considered that the cars are carried on six-wheel trucks which hardly weigh less than 15,000 lb. apiece. What this means may be well brought out by a comparison with the similar ratio for the average 50-ton coal car. There are thousands of these cars in service, the light weight of which varies little from 42,000 lb. There are probably more instances in which this weight is exceeded than there are in which the weight is less. With a light weight of 42,000 lb. and allowing for a 10 per cent overload, the ratio of revenue load to the total gross weight of the car is 72 per cent. There are few cases in which this ratio has exceeded or even reached 73 per cent for cars of 50 tons capacity.

The new car is the second of similar capacity which has been designed by the Norfolk & Western, the first having been a 90-ton gondola car for coal service, and of practically the same light weight. A large number of the former type have now been in service for several years and it is evident that there is no inherent difficulty in securing this high proportion of paying load in cars of this capacity. To do so, however, requires a thoroughness and care in the design and construction which few railroads apparently have the foresight to insist on.

The extent to which cars of capacities greater than 50 tons are being built raises the question as to how far this increase in car capacity may be expected to go. The increases in capacity have led to the development of a 6-in. by 11-in. M. C. B. axle and the Pennsylvania Railroad on its 85-ton hopper car, which is carried on four-wheel trucks, is using axles with 6½-in. by 12-in. journals. In the case of the average 50-ton cars, allowing for a 10 per cent overload, the axle loads with four-wheel trucks are well within the allowable limits for the 5½-in. by 10-in. M. C. B. axle. In fact, a few cars of 55 and 57½ tons rated capacity have been built in which the axle loads have been within or but slightly exceeding the allowable load for this size of axle, which is in the neighborhood of 41,000 lb. at the rail.

The 6-in. by 11-in. axle, which is the largest M. C. B. standard, will provide for cars with four-wheel trucks having a capacity of about 70 tons, the axle load at the rail not exceeding about 53,000 lb. It is questionable whether it is desirable to increase the axle load materially beyond this point when the small arc of contact between the 33-in. wheel and the rail is considered. The use of the six-wheel truck again extends the possibility of increased capacity, but for the standard 6-in. by 11-in. axle, the limit has already been reached in the case of the Virginian 120-ton cars which are designed to have an axle loading of over 52,000 lb.

While few cars of 50 tons capacity have been built having a revenue load ratio exceeding 72 per cent, there are several instances of cars of 55 and 57½ tons capacity in which this ratio has been brought up to 75 per cent. By intensive design there should be possibilities of further increasing this ratio without increasing the size of the car beyond the capacity of four-wheel trucks. There is undoubtedly an advantage in increasing the capacity of coal cars up to the point where maximum loading for a four-wheel truck is reached, aside from the increased paying load ratio which usually follows. This is incident to the reduction in the number of axles and therefore the frictional resistance per ton of train. Beyond this limit, however, when the six-wheel truck is adopted this advantage is immediately lost. It may therefore be questioned just what advantage is obtained by the increase in car capacity beyond a load which may practicably be carried on four-wheel trucks. It would seem that a carefully designed 70-ton car, which does not exceed the capacity of four 6-in. by 11-in. axles, offers practically all of the advantages of cars of higher capacity without exceeding a reasonable wheel load and the additional advantage of avoiding the use of six-wheel trucks.

NEW BOOKS

Proceedings of the International Railway Fuel Association. 416 pages, illustrated, 6 in. by 9 in. Published by the association, J. G. Crawford, secretary, 702 East Fifty-first street, Chicago, Ill. Price, leather bound, $1.50; paper bound, $1.

This is the official proceedings of the ninth annual convention of the Railway Fuel Association, which was held in Chicago, May 14 to 17, 1917. It contains papers with complete discussions on the following subjects: Powdered Coal; Storage Coal; Locomotive Feedwater Heating; Front Ends, Grates and Ash Pans; Car Shortage and Coal Shortage; Conservation Appeal; Council of National Defense; Fuel Economy in Relation to Reducing the Cost of Kindling Fires in Locomotives; Fuel for Small Furnaces; Graphical Daily Records of Performances of Enginemen and Locomotives; Soot; Tests of Six Grades of Coal from a Franklin County (Illinois) Mine, and Theory, Practice and Results of Fuel Economy. Of particular interest are the papers and discussion on locomotive feedwater heating and the tests made by the University of Illinois for the association on Illinois coal. Unlike the majority of the organizations of railroad officers, this association did not cancel the annual convention of the past year. Instead it endeavored to make the meeting helpful to the members in handling the new problems caused by the war.

The appeal for conservation of fuel, which was given wide publicity at the time of the convention, deserves more than passing attention.

COMMUNICATIONS

THE RAILWAY EMPLOYEES' "BIT"

KANSAS CITY, MO.

TO THE EDITOR:

So much has been said lately about the efficiency of machinery and methods needed to win the war, that I feel impelled to call attention to the importance of the personal equation and our attitude.

Among the supervisors of departments and shop foremen we find a few who are living in the wrong age. They do not seem to realize that trying to drive men is long since out of date and much better results are obtained by treating an employee like a man and rewarding faithful effort with a generous word, if nothing more. Do you think that the foreman who always wears a frown, reprimands a man in the presence of fellow workers and gives his orders in a domineering, slurring manner, is working for the best interests of his employer and of his country? Certainly not. Such men are impeding our progress and interfering with the successful prosecution of the war.

If the browbeating foreman is hurting our cause, so also is the workman who continually picks the easiest job he can find and then does as little at it as possible.

Since our country entered the war some remarkable achievements have been attained by the great army of railroad workers. So let us continue the good work and cooperate in every way for the solution of our common problem.

All unnecessary work must take second place and attention be concentrated on matters of vital interest. Paint and polish will never carry our grain from the middle west to the boys in France. We must watch our scrap piles and prove the fallacy of that old proverb as to the extravagance and improvidence of American methods. The welding process has made possible the reclamation of many articles. Use it to the fullest extent. Keep the drop pit busy so that locomotives with light mileage will not block the back shop, and above all, let every one of us be awake to his job, and wear a smile if it hurts. M. C. WHELAN.

T. W.'S SPY WORK COMES TO NAUGHT

(With apologies to Wallace Irwin)

CHICAGO, ILL.

DEAR EDITOR:

Sherman were correct; however, illustrious warrior receive greater acclaim if he had assume job of I. C. C. detector for few month or spend six weeks in easy chair absorbing duty of rr general manager which deal with brotherhood bolsheviki. The object of these reflection are the following towit: For four year, I have collect with elaborate finesse complete data to erect Locomotive Rogue Gallery. This are divided by railroad and state and are across file to select any number if so desire. I have perform this secret service unknown to U. S. government and rr official.

This tickle system show me at glance date when penalty due on flues not remove, jacket remove for examination, flexible staybolt cap ready to come off. It also record worst tire, date of hydro-estatic test also any little defect which afford ground for Form 5 invitation on mm. Whenever I make journey on particular rr, this index are consult for possible offender. I have scheme fix so I can take list of engine due and be ready to issue card on sight if she are working overdue. Old locomotive are choice game on account of safety factor get tighter each year and it are difficult job to change staybolt spaces, thickness of sheet, ancient method of rivets to comply with efficiency of joint.

However this are same as inquest now. Just as elaborate case are complete and victory within grasp, just as game are ready to fall in bag. Big Chief at Washington announce oxygen treatment for patient which is same as calling armistice on Bug river to panting Red Guard of Petrograd. Announcement say flue are good for duration of war, jacket can stay on added period equal to length of war, staybolt caps examination are extend six months, electric headlight capacity to see normal man on normal track in normal weather with normal visage 800 feet away are postpone nine month—other penalty defect are to be dealt on with same lenience. My overtime now do not bring emolument of one half instead of time and a half. I are complete discourage. Since RR men also work for U.S. gov't, it maybe constitute treason or less majesty at least to issue Form 5 invitation on soldier of U.S.A. formerly common rr master mechanic.

It are of course impossible, however, I yearn to converse a few sentences with honorable general mention in prelude.

Yours truly, TOBESURA WENO.

BOILER DESIGN—COMBUSTION

NEW YORK.

TO THE EDITOR:

Your article in the January number on the advantages to be derived from the utilization of the university test plants in the investigation of problems of locomotive design calls attention to our limited and hazy knowledge concerning many factors that enter into locomotive design.

A correct determination of the relations between grate area, firebox volume, length of combustion chambers and length and diameter of flues means much—not only from the theoretical standpoint of generation and transfer of heat, but from the practical standpoint of boiler maintenance and repair.

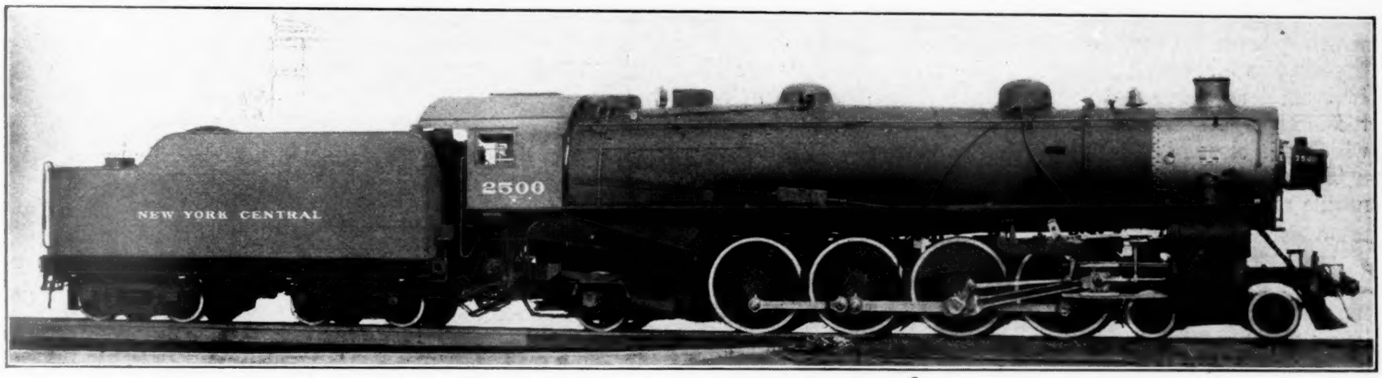
Insofar as the boiler is concerned, the problem is not only to get a design that will give the maximum capacity with high efficiency, but also to get a design that will give maximum service with a minimum amount of attention and repairs. Cracked flue sheets, leaky flues, and flues plugged with cinders and slag are sources of constant trouble; and a large part of locomotive failures and terminal delays are directly traceable to these causes. Anything that will eliminate or reduce these troubles will increase the efficiency of our railroads.

The experience of some railroads owning locomotives equipped with barrel combustion chambers of generous length and flues of moderate length, indicates that such an arrangement is not only conducive to higher boiler capacity and efficiency, but also reduces the troubles mentioned above. It is obvious that what might be termed a "floating" flue sheet (such as used in a barrel combustion chamber) should give less trouble than the comparatively "rigid" flue sheet as used in the ordinary firebox. The use of flexible staybolts and welded seams has eliminated the most objectionable features of the combustion chamber; and the designs at present used permit a freedom of movement that cannot be had with the straight flue sheet rigidly secured to the mud ring.

Moving the flue sheet forward with the installation of a combustion chamber also reduces the temperatures to which it is subject, and reduces the wide variations in temperature which are constantly occurring in the ordinary firebox, and which are the source of most of our flue troubles.

The plugging of flues is due to imperfect firebox conditions—and anything that can be done to increase the thoroughness of combustion will reduce these troubles. Combustion chambers do increase the effectiveness of combustion and reduce the trouble due to flues honeycombing.

Entirely apart from all theoretical considerations, the questions which you have raised point the way to developments that will make the locomotive not only a more efficient machine in service, but one that is more practical and economical from a maintenance standpoint. J. T. ANTHONY.



N. Y. C. 4-8-2 Type Freight Locomotives

Over 2,600 Drawbar Horsepower Has Been Developed; Capacity at High Speeds Is Well Sustained

CONSIDERABLY more than a year ago the New York Central received from the American Locomotive Company its first order of 30 locomotives of the 4-8-2 type, which in several respects are the most notable locomotives of this type yet built. Since that time orders have been placed for more of these locomotives until at present there are nearly two hundred of them either in service or on order.

Heretofore locomotives of this wheel arrangement invariably have been built to handle heavy passenger trains over mountain grades under conditions making difficult the maintenance of schedules with Pacific type locomotives. Locomotives of this wheel arrangement have therefore come to be known as the Mountain type. On the New York Central, however, the 4-8-2 type locomotives have been built for freight service on a line with comparatively few grades, on which, to an unusual extent, car limits determined by operating conditions and facilities other than motive power are the determining factors in the length of trains. The type name generally applied to these locomotives is obviously a misnomer in this case and these locomotives have therefore been styled the "Mohawk" type on the New York Central, after the name of the division upon which they were first placed in service.

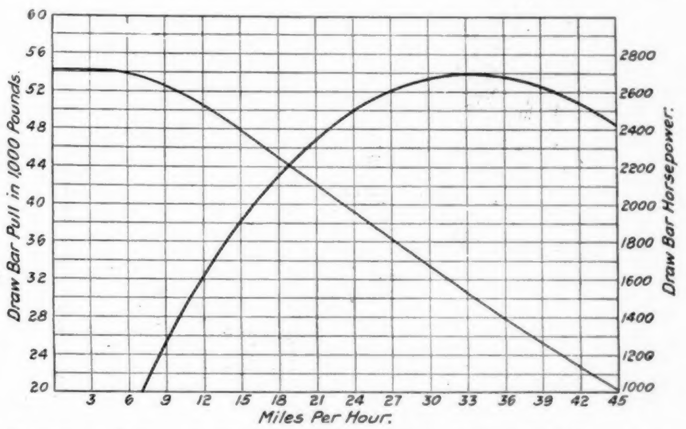
It will be noted that the average load per pair of driving wheels in the case of the 4-8-2 engines has been kept well within 60,000 lb., and they have been designed to take curves up to 19 deg. With their well designed reciprocating parts they should cause little difficulty in the maintenance of track.

Tractive efforts developed at the various speeds and the corresponding drawbar horsepowers are exhibited by the drawbar pull-speed chart, plotted from results obtained in dynamometer car tests with a steam pressure of 200 lb. per sq. in. It will be noted that the tractive effort of the locomotive is well sustained at the higher speeds.

On the basis of Cole's ratios, these locomotives should develop a maximum cylinder horsepower of 2,683 at a piston speed of 1,000 ft. per minute. In determining the ratio of boiler capacity to maximum cylinder demand, Cole's ratios are based on a steam consumption of 20.8 lb. per indicated horsepower-hour for superheater engines, and the grate is proportioned to burn four pounds of coal per indicated horsepower-hour at a rate not to exceed 120 lb. per square foot of grate area per hour. On this basis of comparison, the evaporative capacity of the boiler is equal to 98 per cent of the maximum cylinder demand, while the grate area is proportionately slightly smaller.

The boiler is of the conical type with an outside diameter of 81 7/16 in. at the first ring. The engines as originally built carried 185 lb. but the boilers were designed to carry a working pressure of 200 lb. and the pressure has been raised to 190 lb. per square inch since the engines went into service.

It will be seen that instead of the usual type of rod braces at the front and back heads, the heads of the boiler of the



Drawbar Pull and Drawbar Horsepower Characteristics of the New York Central 4-8-2 Type Locomotive with Boiler Pressure at 200 lb. per Sq. In.

"Mohawk" type locomotives are braced with gusset sheets, the ends of which are bolted between angle bars forming the flanges for attachment to the boiler head. Where attached to the roof sheet the back head braces are flanged to conform to the curve of the sheet, while each front gusset sheet is bolted to the radial leg of an angle bar. The other leg of this angle bar forms the flange for securing the brace to the boiler shell.

The longitudinal seam of the dome course is on the top center line. It is of the butt joint type with inside and outside welt strips and the butt joint is welded throughout the length of the seam. The dome is of pressed steel formed in one piece and the flanges are extended in strips 13½ in. and 14 in. wide respectively, in front of and back of the dome, to form the outside welt strip of the barrel seam. The inside welt strip is bifurcated at the dome and forms the reinforcing pad under the dome flange.

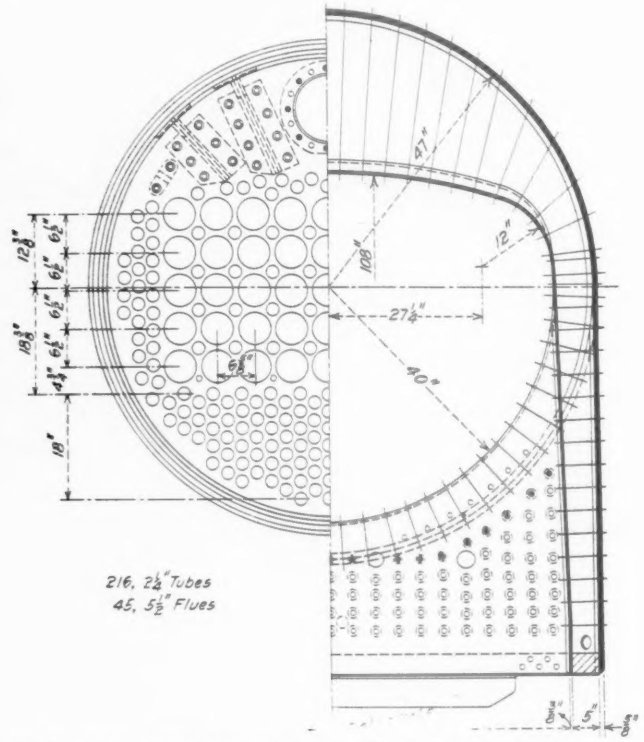
There are no unusual features in the firebox construction. It is fitted with a Security brick arch carried on four tubes three inches in diameter and has a barrel combustion chamber

which extends forward into the barrel of the boiler 40⅞ in. beyond the firebox throat sheet. The tubes and flues are 21 ft. 6 in. long, measured over the tube sheets. As built, the locomotives are hand-fired through two firedoor openings which are closed with air-operated firedoors.

The front end arrangement includes a 6¾-in. exhaust nozzle and a 19-in. stack extension which extends down to a point 3¾ in. above the center line of the smokebox.

The main frames and the single front rails under the cylinders are cast in one piece on each side. The top rail over the pedestals has a section 6 in. wide by 7 in. deep. The lower rails are 4½ in. deep at the smallest section, increasing to a depth of 5¼ in. over the ends of the pedestal binders. The rear frame and back deck plate are an integral steel casting, the forward ends of which are bolted to the rear ends of the main frames. The radius bar fulcrum, the pockets for the rear ends of the trailer springs and the trailer equalizer bar fulcrums are all an integral part of this casting.

With the exception of those for the main pair of drivers, the driving journals are 11 in. in diameter by 13 in. long.

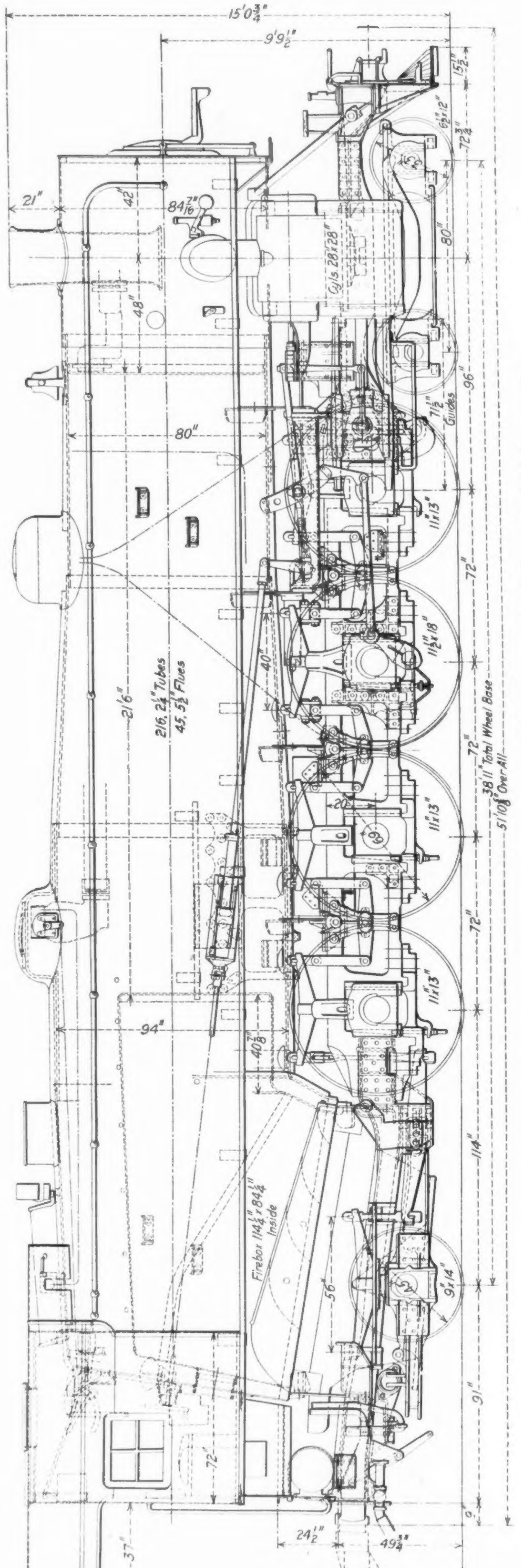


The Tube Sheet Layout and Section Through the Firebox

The journals of the main drivers are 11½ in. in diameter and 18 in. long. Except for their length, the driving boxes used on this axle are similar in construction to those ordinarily used where the center line of the driving box and the center line of the frame coincide. The main jaws are widened by the use of steel castings which are bolted against the inside face of the pedestals. These castings also perform the function of frame crossties. By the introduction of offset cross equalizers in the spring hanger system at either end of the main driving springs, the position of the main springs has been moved in so that they are located directly over the longitudinal center line of the driving boxes. Each spring rests in a saddle of the usual type designed to clear the offset position of the frame rail relative to the center line of the box.

Steam is admitted to the valve chambers through an outside dome connection type of throttle valve and distributed by 14-in. piston valves having a travel of 7 in. The valves are operated by the Walschaert valve gear, fitted with the Ragonnet power reverse gear.

The engines are fitted with Woodward engine trucks and

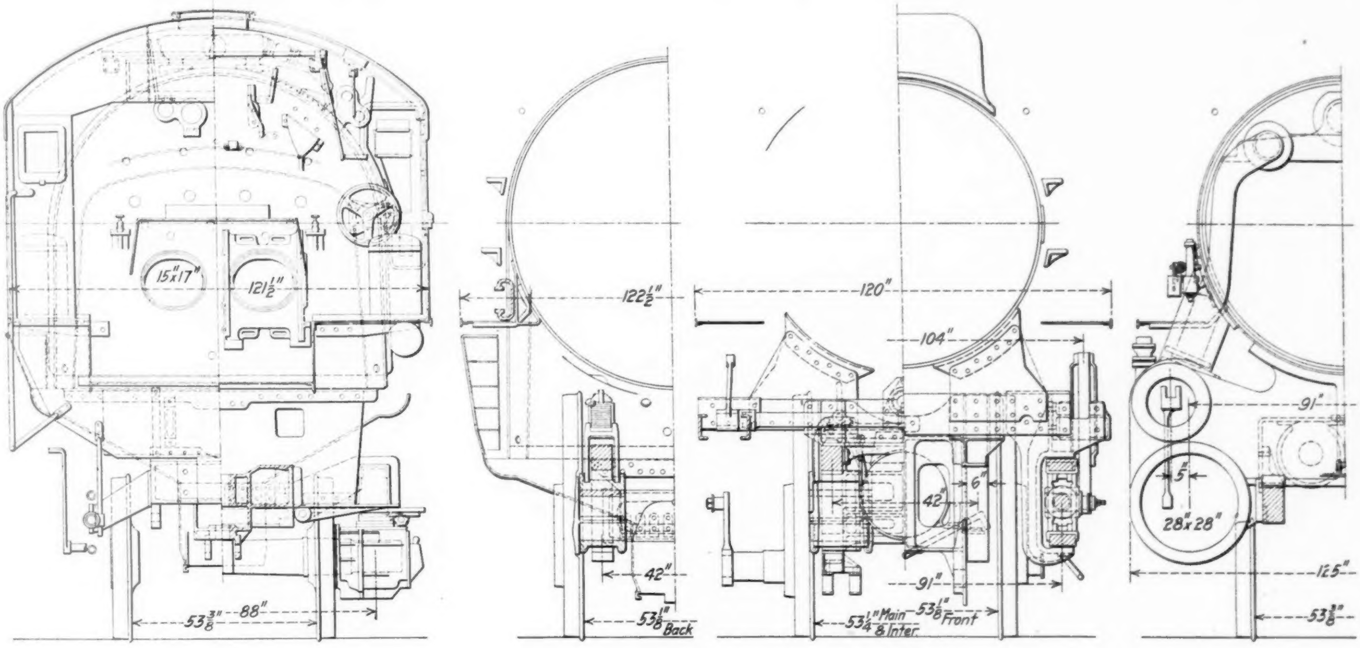


Elevation Showing the General Arrangement of the New York Central 4-8-2 Type Freight Locomotive

Cole radial trailing trucks. The engine truck has a swing of 4¼ in. on each side, and the swing of the trailing truck is 5¼ in. on each side.

It is evident that the development of the full capacity of a locomotive capable of delivering 2,600 indicated horsepower with a coal consumption of approximately three pounds per horsepower-hour, thus requiring the combustion of about 7,800 lb. of coal per hour, is beyond the possibility of attainment by hand firing. As the locomotives are hand fired, they

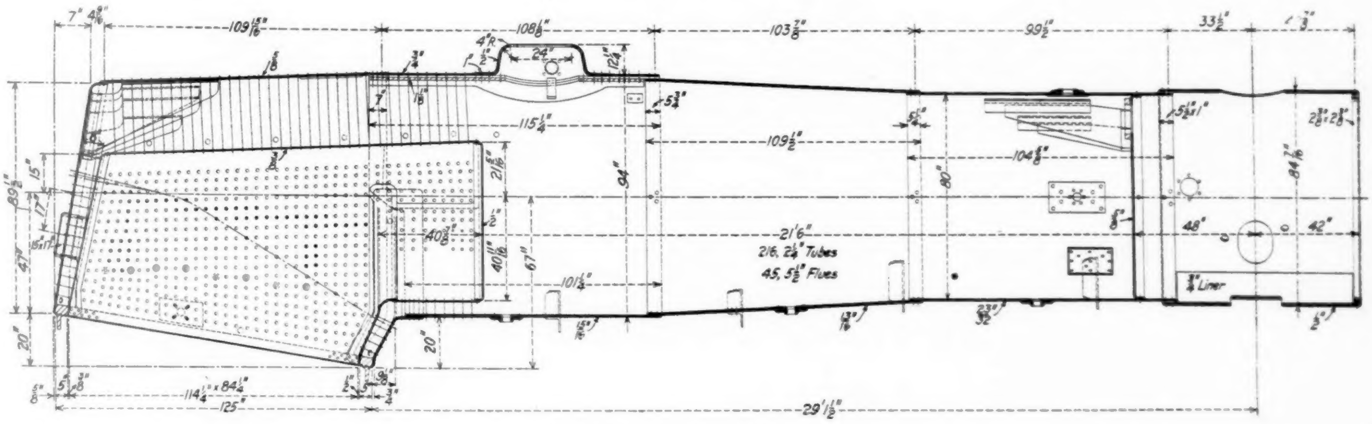
Tractive effort	51,400 lb.
Weight in working order	343,000 lb.
Weight on drivers	234,000 lb.
Weight on leading truck	52,500 lb.
Weight on trailing truck	56,500 lb.
Weight of engine and tender in working order	509,500 lb.
Wheel base, driving	18 ft.
Wheel base, total	38 ft. 11 in.
Wheel base, engine and tender	72 ft. 9 in.
Ratios	
Weight on drivers ÷ tractive effort	4.6
Total weight ÷ tractive effort	6.7
Tractive effort × diam. drivers ÷ equivalent heating surface*	567.6



Cross Sections of the New York Central Locomotive

have never developed their full capacity in regular road service. They have been able to decrease the time required to handle tonnage trains over the division, and in fast freight service they handle actual tonnage of from 2,500 to 3,500 tons, in adjusted tonnage trains of 75 to 95 cars, over a division 139 miles long in from five to eight hours' total time on the road. The engines have been built so that stokers may

Equivalent heating surface* ÷ grate area	93.5
Firebox heating surface ÷ equivalent heating surface,* per cent	5.1
Weight on drivers ÷ equivalent heating surface*	37.5
Total weight ÷ equivalent heating surface*	55
Volume both cylinders	20 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	312.4
Grate area ÷ vol. cylinders	3.3
Cylinders	
Kind	Simple
Diameter and stroke	28 in. by 28 in.



Sectional Elevation of the Boiler

readily be applied whenever traffic conditions require the use of their total horsepower capacity. In the meantime advantage is being taken of the more efficient combustion obtained under the conditions of hand firing.

The principal dimensions and data are given in the following table:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Outside lap	1 in.
Inside clearance	0 in.
Lead	¼ in.

Wheels

Driving, diameter over tires	69 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11½ in. by 18 in.
Driving journals, others, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	33 in.

Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	45 in.
Trailing truck, journals	9 in. by 14 in.
Boiler	
Style	Conical
Working pressure	190 lb. per sq. in.
Outside diameter of first ring	81 7/16 in.
Firebox length and width	114¼ in. by 84¼ in.
Firebox plates, thickness	Crown, sides and back, ⅜ in.; tube, ½ in.
Firebox, water space	5 in.
Tubes, number and outside diameter	216—2¼ in.
Flues, number and outside diameter	45—5½ in.
Tubes and flues, length	21 ft. 6 in.
Heating surface, tubes	4,110 sq. ft.
Heating surface, firebox, including arch tubes	320 sq. ft.
Heating surface, total	4,430 sq. ft.
Superheater heating surface	1,212 sq. ft.
Equivalent heating surface*	6,248 sq. ft.
Grate area	668 sq. ft.
Tender	
Tank	Water bottom
Frame	Cast steel
Weight	166,500 lb.
Wheels, diameter	36 in.
Journals, diameter and length	5½ in. by 10 in.
Water capacity	8,000 gal.
Coal capacity	14 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

UNIVERSITY OF ILLINOIS COAL TESTS*

Comparative High and Medium Capacity Performance of Various Grades in Locomotive Service

THE tests, the results of which are here set forth, were made by the Railway Engineering department of the University of Illinois in co-operation with the committee on Fuel Tests of the International Railway Fuel Association and the United States Bureau of Mines. Their general purpose was to determine the relative value in locomotive service of various grades of coal.

For this purpose six sizes of coal chosen by the International Railway Fuel Association committee were tested in the locomotive laboratory, on a Mikado type locomotive loaned by the Baltimore & Ohio. These grades were mine run, 2-in. by 3-in. nut, 3-in. by 6-in. egg, 2-in. lump, 2-in. screenings, and 1¼-in. screenings, all from United Coal Mining Company's Mine No. 1 at Christopher, Franklin County, Illinois.

The general test program involved for each grade of coal six tests, three of which were made at a medium rate of evaporation, and the remaining three at a high rate. The medium rate was chosen to represent an average rate of working the locomotive, in so far as it is possible to define such an average. During tests run at this medium rate about 23,000 lb. of water were evaporated an hour under the prevailing conditions, from 3,100 to 4,300 lb. of coal were fired per hour, and the engine was worked at 33 per cent cut-off and at about 19 miles an hour, developing approximately 1,300 indicated horse power and about 22,500 lb. drawbar pull. During tests when the engine was worked at the high rate of evaporation, about 43,000 lb. of water were evaporated an hour, the hourly coal consumption varied from about 7,000 to 9,300 lb., the cut-off and speed were respectively 55 per cent and 26 miles per hour, while the horse power was about 2,200, and the drawbar pull about 28,500 lb.

THE COAL USED

The averages of the coal analyses for all tests made with each grade of coal are presented in Table I. The uniformity of the analyses and of the heating values make it clear that such differences in performance as developed between the various grades are due chiefly to differences in their mechanical makeup, and only in small measure to differences in their chemical composition.

TABLE I—THE CHEMICAL ANALYSIS AND HEATING VALUE OF THE COALS

	Proximate analysis, coal as fired					Calorific values			Ultimate analysis, coal as fired				
Grade of coal	Moisture, per cent	Volatile matter, per cent	Fixed carbon, per cent	Ash, per cent	Sulphur separately determined, per cent	Per lb. of coal as fired, B.t.u.	Per lb. of dry coal, B.t.u.	Per lb. of combustible, B.t.u.	Carbon, per cent	Hydrogen, per cent	Nitrogen, per cent	Oxygen, per cent	Moisture in coal determined from sample taken at mine, per cent
Mine run	8.14	34.18	47.92	9.76	0.95	11,873	12,926	14,463	66.63	4.28	1.55	8.69	7.82
2-in. by 3-in. nut	8.60	34.83	47.70	8.87	0.88	11,957	13,082	14,487	67.50	4.36	1.38	8.42	8.48
3-in. by 6-in. egg	8.82	34.57	48.56	8.06	0.94	12,071	13,239	14,523	68.19	4.50	1.51	7.99	....
2-in. lump	9.27	34.46	47.49	9.07	0.88	11,817	13,023	14,469	66.34	4.23	1.49	8.73	....
2-in. screenings	9.25	32.05	48.12	10.59	0.85	11,550	12,727	14,408	65.74	4.43	1.48	7.66	....
1¼-in. screenings	9.09	32.34	48.01	10.57	0.97	11,557	12,711	14,385	65.49	4.35	1.43	8.10	9.07

Due to differences in the nature of the coal, in mining methods, and in methods of preparation, there is frequently much uncertainty about the meaning of such terms as "mine run," "lump," etc. The laboratory has devised a method of screening samples of the coals used during tests for the purpose of separating them into their size elements.

Three carloads each of mine run and lump, and two carloads of each of the other four grades were received at the laboratory. Samples were screened by means of a specially designed shaker screen operated by pulley-driven eccentrics running at a speed of 80 revolutions per minute. Five screens were used perforated respectively with 4-in., 2-in., 1-in., ½-in. and ¼-in. holes. In this way the sample was divided into six parts whose size limits were as designated by the headings of columns 2 to 7 in Table II. These parts were then weighed and the ratios of their weights to that of the original sample were calculated.

All grades except the mine run and lump were fired in exactly the condition in which they arrived at the laboratory, except for the breakage incident to unloading and the insignificant breakage due to shoveling into the charging wagons. Since, however, the mine run and the lump coals contained as usual a considerable proportion of lumps too large for proper firing, the attempt was made to break these two grades down to the extent to which, in the judgment of those in charge of the tests, these grades are generally broken down at the coal chute. These two coals as fired contain, therefore, a smaller proportion of large lumps than when they were received.

THE TESTS

The locomotive used during the tests was loaned for the purpose by the Baltimore & Ohic. It is of the Mikado type developing 54,587 lb. tractive effort and was built by the

*From the report of the committee on fuel tests of the International Railway Fuel Association, presented at the 1917 convention.

Baldwin Locomotive Works during the summer of 1916. It arrived at the laboratory in excellent condition.

The boiler was of the wagon-top type with radial stays, carrying 190 lb. pressure and having 3,630 sq. ft. of heating surface. It was equipped with a Schmidt 34-element superheater, having a heating surface of 1,030 sq. ft., a Street stoker, and a Security brick arch carried on four tubes. The front end was self-cleaning and was equipped with a plain 6-in. round nozzle-tip without bridge or split, which was used throughout all tests. The total air opening through the grates amounted to 17 sq. ft. or 24.4 per cent of the 69.8 sq. ft. of grate area. The area of the air inlet to the ash pan amounted to 8.3 sq. ft. or 49 per cent of the air opening through the grates. A Franklin pneumatic door of the butterfly type was used during all tests except those with the two sizes of screenings, which were fired by means of the Street stoker.

An inspection of the values of equivalent evaporation per pound of dry coal as obtained from each test disclosed great uniformity among the values applying to each grade of coal and each rate of combustion. In view of this uniformity we are entirely warranted in using the average values for the various groups and in basing conclusions upon them. These averages of equivalent evaporation per pound of dry coal are therefore assembled in Table III together with the averages of the rate of evaporation per square foot of heating surface per hour.

The relations shown in Table III stand out more clearly in Fig. 1. Inspection of Fig. 1 reveals, as usual, for all grades a sharp decrease in evaporation as the rate of evaporation increases. The rate of this decrease is nearly alike for all grades except the 2-in. by 3-in. nut, for which it is roughly one-half of that for the other grades. This change in evaporation with rate of evaporation makes it necessary to reduce the values of evaporation to a common rate before drawing final comparisons between the various grades. To effect this reduction the rates of evaporation for the medium rate tests have been averaged and this average—6.70 lb. per sq. ft. of heating surface per hour—has been represented by the vertical line *AA* in Fig. 1. Similarly the average high rate—12.46 lb. per sq. ft. of heating surface per hour—is defined by the line *BB*. If we measure off the vertical distances on *AA* at the points where this line is intersected by the performance lines for the various grades we obtain six values of equivalent evaporation per pound of dry coal, one for each grade, which are rigidly comparable; in like manner the evaporation values defined by the intersections with the line *BB* are comparable.

At the medium rate the four larger grades gave nearly the same performance, the maximum difference among them being but four per cent. The steam production per pound of egg coal was two per cent greater than with the mine run, while with the lump and the nut it was respectively one per cent and two per cent less than with mine run. The performance with 2-in. screenings was seven per cent less

TABLE II—SIZE ELEMENTS OF THE COALS AS RECEIVED AT THE LABORATORY

Grade of coal 1	Per cent over 4-in. screen 2	Per cent through 4-in., over 2-in. screen 3	Per cent through 2-in., over 1-in. screen 4	Per cent through 1 in., over ½-in. screen 5	Per cent through ½-in., over ¼-in. screen 6	Per cent through ¼-in. screen 7	Total 8
Mine run	29.6	22.3	16.8	11.4	7.4	12.5	100.0
2-in. by 3-in. nut	....	63.9	30.3	2.8	1.1	1.9	100.0
3-in. by 6-in. egg	41.0	48.3	5.3	2.0	1.1	2.3	100.0
2-in. lump	61.6	26.4	7.5	1.9	.9	1.7	100.0
2-in. screenings	....	....	33.2	25.7	14.2	26.9	100.0
1¼-in. screenings	....	....	4.5	37.9	20.0	37.6	100.0

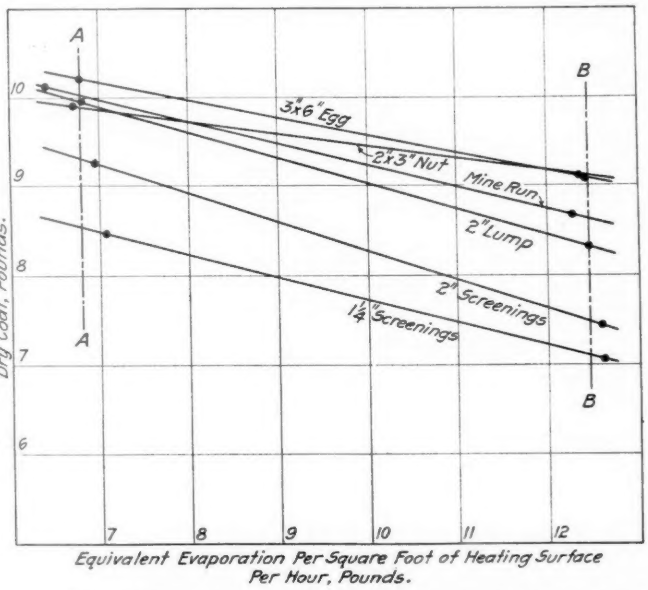


Fig. 1—The Relation Between Equivalent Evaporation Per Pound of Dry Coal and the Rate of Evaporation

TABLE III—EQUIVALENT EVAPORATION PER POUND OF DRY COAL

1	2	3	4	5
	For the medium rate tests		For the high rate tests	
Grade of coal	Equivalent evaporation per lb. of dry coal, lb.	Equivalent evaporation per hour per sq. ft. of heating surface, lb.	Equivalent evaporation per lb. of dry coal, lb.	Equivalent evaporation per hour per sq. ft. of heating surface, lb.
3-in. by 6-in. egg	10.21	6.78	9.09	12.42
Mine run	10.12	6.40	8.66	12.28
2-in. lump	9.95	6.82	8.32	12.46
2-in. by 3-in. nut	9.90	6.72	9.11	12.39
2-in. screenings	9.25	6.95	7.43	12.59
1¼-in. screenings	8.47	7.07	7.06	12.61

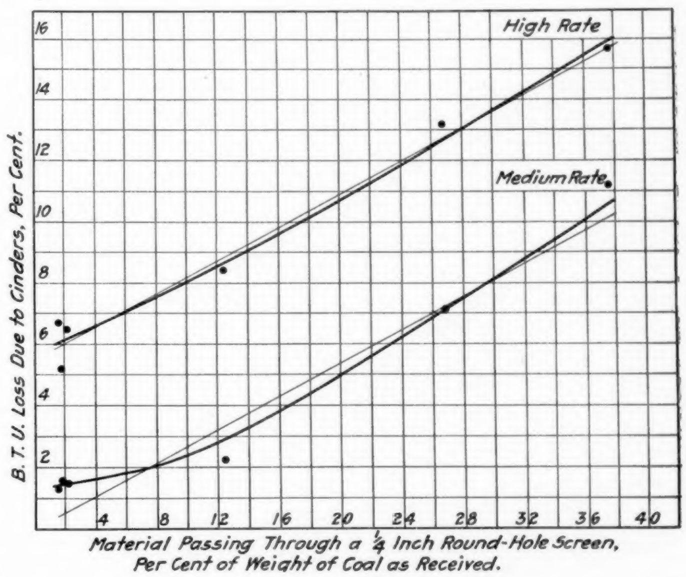


Fig. 2—The Cinder Loss in Relation to the Fine Material in the Coal

and with 1¼-in. screenings 15 per cent less than with mine run. If we assume that mine run coal on the tender is worth $2 per ton the relative worth on the tender of the other grades during the medium rate tests was:

3-in. by 6-in. egg	$2.04
2-in. lump	1.98
2-in. by 3-in. nut	1.96
2-in. screenings	1.86
1¼-in. screenings	1.70

At the high rate the 2-in. by 3-in. nut coal gave the best performance, producing six per cent more steam than the mine run; the 3-in. by 6-in. egg comes next with an evaporation 5 per cent more than that of the mine run; while the 2-in. lump evaporated three per cent less. At this rate of evaporation the 2-in. screenings and the 1¼-in. screenings produced per lb. respectively 13 per cent and 18 per cent less steam than the mine run. If we again assume that mine run is worth on the tender $2 per ton, the relative worth of the other grades during the high rate tests was as follows:

2-in. by 3-in. nut	$2.12
3-in. by 6-in. egg	2.10
2-in. lump	1.94
2-in. screenings	1.74
1¼-in. screenings	1.64

In considering the cinder losses as here presented it should be borne in mind that all of the coal tested was of one kind, that is, it came from one mine. Coals possessing other physical characteristics might show somewhat different results as to cinder losses under the conditions of the tests here considered. It should also be remembered that for a given rate, medium or high, the draft was, for all grades of coal, practically constant.

The average heating value of the stack cinders for all medium rate tests was 8,635 B. t. u. and the average value for all high rate tests was 10,854 B. t. u. The heating values of the cinders from the medium rate tests with screenings were higher than corresponding values from other grades of coal. When the losses are expressed as B. t. u. percentages, the average loss from the screenings was roughly five times as great as the average loss from the larger coals during the medium rate tests. For the high rate tests the average loss from screenings was more than twice as great as the average loss from the larger coals.

The data indicates that with very fine coals such as screenings the cinder loss is large even at medium rates of combustion and with comparatively low front-end draft; but that under these conditions the cinder loss is not serious for the larger coals even when they contain a considerable amount of fine material, as in mine run coal. For conditions involving high rates of combustion and strong drafts, the stack cinder loss is a serious one for all grades of coal.

Fig. 2 shows the relation existing between the loss due to stack cinders and the amount of ¼-in. or smaller material in the coal as received. The light straight lines show for both rates, a uniform increase of one per cent in cinder loss for each 3.7 per cent increase in the ¼-in. material in the coal. The straight line represents the plotted points of the high rate tests closely but does not so well represent the points plotted for the medium rate tests.

Generally speaking, the relations between the various elements of the heat balance for the different grades are nearly the same for the medium rate tests as for the high rate tests. All losses except those due to stack cinders are fairly constant for all grades of coal and the differences in the amount of heat absorbed by the boiler are accounted for, almost entirely, by the variations in the losses due to stack cinders.

CONCLUSIONS

Comparing mine run with 3-in. by 6-in. egg, we find the egg was 2 per cent better at the low rate and 5 per cent better at the high rate. The B. t. u. value of the egg was 2 per cent more than that of the mine run. This accounts for the difference at low rate and brings the high rate difference to 3 per cent, but when it is considered that the stack cinders were 2.2 per cent of the egg fired at low rate and 3.1 per cent of the mine run fired at low rate and 7.2 per cent of the egg fired at high rate and 9.0 per cent of the mine run fired at high rate, it is evident that the increased cinder loss of mine run coal over 3-in. by 6-in. egg is in part offset by the better combustion of the smaller particles of coal which exist in greater percentage in the mine run.

The higher standing of 2-in. by 3-in. nut than mine run at high rate is due to the lesser cinder loss and to the even and uniform condition in which it is possible to keep a fire using 2-in. by 3-in. nut. At the medium rate we believe the lower standing of the 2-in. by 3-in. nut in comparison with mine run was due to the necessity of carrying too thin a fire with the nut. At the low rate the 2-in. lump is one per cent below the mine run and three per cent at the high rate. When firing 2-in. lump it was reduced to such size that about 74 per cent would pass through a 5-in. round opening, whereas all of the mine run as fired would pass through that size opening. The 2-in. lump was cracked to about the same size as it would be at a coal chute where the coal is cracked and passes through breaker bars spaced 5-in. in the clear. There were consequently not the large pieces in the mine run that there were in the lump and the committee concludes that cracking coal so it will pass through a 5-in. round or 6-in. round opening is worth more than it costs.

Under ordinary circumstances mine run coal from this district can be purchased at from 15 cents to 25 cents less per ton than 2-in. lump, and 2-in. by 6-in. egg or 3-in. by 6-in. egg, and the egg and lump are often considered more economical and satisfactory than Mine Run. Where this price differential exists, it would pay to increase supervision to the point where mine run can be handled as satisfactorily by all firemen as the lump and egg.

At the low rate the 2-in. screenings were 9.2 per cent better than the 1¼-in. screenings, and at the high rate 5.2 per cent better than the 1¼-in. screenings. At medium rate the cinder losses are not serious for the four hand-fired grades, but at high rate they are greater than is desirable. At both medium and high rates with the stoker fired grades these losses are very high though not enough to wipe out the ordinary price differential existing between the hand fired and stoker fired grades. This shows the importance of using on stoker engines as large screenings as the price differential will permit.

One of the problems which is beginning to confront railroads using stokers is what fuel efficiency will be obtained when using mine run hand fired in comparison with screening this mine run into 2-in. lump for hand fired engines and 2-in. screenings for stoker fired engines. Assuming that the mine run splits into 52 per cent of lump and 48 per cent of screenings, we find that using mine run as 100 per cent the lump and screenings give 96 per cent of the efficiency of mine run at the low rate and 92 per cent at the high rate. This of course applies to both lump and mine run as cracked on these tests.

We recommend that all tests and data covering locomotive tests and boiler design be accompanied by a complete description of the character and size of the coal, also that the coal fired is of an average grade.

The difference between mine run, 2-in. lump, 3-in. by 6-in. egg, and 2-in. by 3-in. nut are such that they could not have been determined by the ordinary road tests where only two or three round trips using each grade of coal would have been made, and the committee wishes to call attention to the fact that a very large number of road tests must be made to get a reliable average.

The report was signed by J. G. Crawford, chairman, H. B. Brown, W. P. Hawkins, O. P. Hood, L. R. Pyle, W. L. Robinson and E. C. Schmidt.

Santa Fe 2-8-2 Type Locomotive

Same Tractive Effort but Increased Power Capacity, as Compared with an Earlier Class of the Same Type

An order of heavy Mikado type locomotives, built by the Baldwin Locomotive Works, has recently been placed in service by the Atchison, Topeka and Santa Fe. These engines are coal burners and were developed from the design of a lighter Mikado type locomotive, a number of which were built in 1916. The new design was worked out conjointly by the railway company and the builders, and existing Santa Fe standards were used generally throughout the construction. The character of the change in the design is shown by the following comparison of the leading dimensions of the new locomotives with those of the previous engines:

Date built	Cylinders, dia. and stroke, in.	Diameter drivers, in.	Steam pressure, lb.	Grate area, sq. ft	heating surface, sq. ft.	Superheating surface, sq. ft.	Weight on drivers, lb.	Weight, total engine, lb.	Tractive effort, lb.
1916.....	25 by 32	57	200	58.5	4,111	880	228,000	292,400	59,600
1917.....	27 by 32	63	190	66.8	4,614	1,086	228,900	314,900	59,800

Wheel load limitations prohibited a material increase in the weight on drivers, as compared with the design of 1916; and while the new engines are heavier, the additional weight is carried on the front and rear trucks. The principal advantage derived from this greater weight is the increased steaming capacity of the enlarged boiler. With this additional steam supply the larger cylinder horse-power incident to the use of driving-wheels of greater diameter can be developed. For an increase in total weight of not quite eight per cent there has been an increase in water heating surface of over 11 per cent. The starting tractive efforts, with steam pressures giving approximately the same ratio of adhesion, are practically the same for both locomotives, but the larger cylinders, wheels and boilers of the new engines give them greater horse-power capacity. This additional power will be utilized in maintaining higher speed with the same or possibly a little greater tonnage.

The boiler is of the extended wagon top type, designed for a pressure of 225 lb. per sq. in., but in service carrying 190 lb. It contains a 43-element superheater, and the firebox is equipped with a brick arch supported on four tubes. An auxiliary dome, mounted over an opening in the shell of sufficient size for inspection purposes, is placed back of the main dome and on the same course with it. A single liner is placed under both domes; it also covers the longitudinal seam, which is placed on the right hand side of the center line.

The boiler accessories include a power-operated fire-door and grate shaker. The minimum air opening specified for the ash-pan is 15 per cent of the grate area. The throttle valve is fitted with an auxiliary drifting valve.

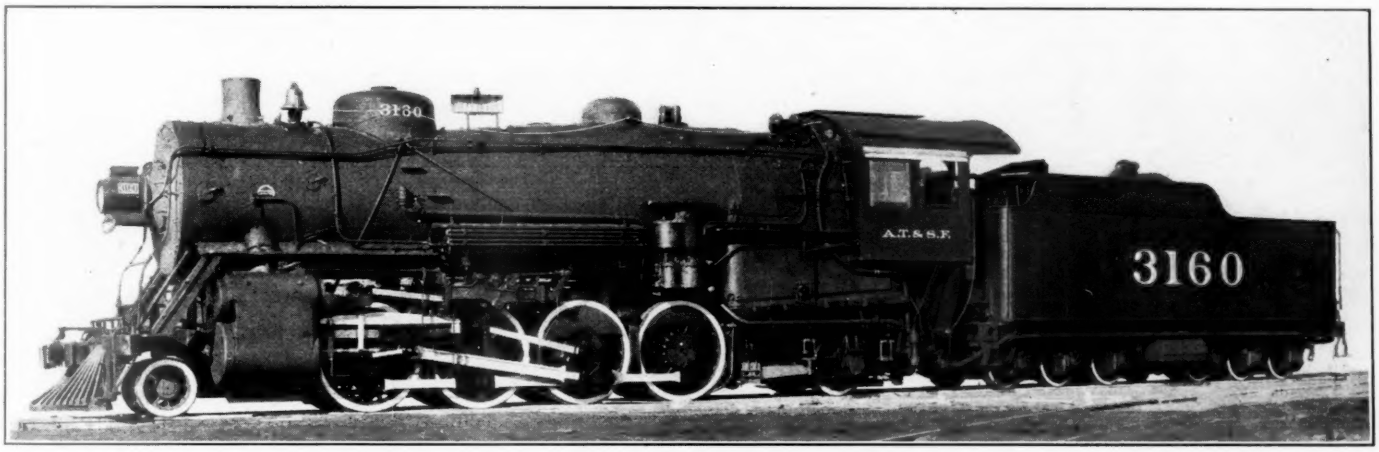
The cylinders are designed with direct exhaust passages of ample area, free from abrupt bends. Gun iron is used for the cylinder and steam chest bushings, piston and valve bull and packing rings, and crosshead shoes. The piston heads are of rolled steel, and the crosshead bodies of .40 carbon cast steel of the Laird design. Special steels are used for the piston rods, valve stems, main and side rods and main crank pins. The Baker valve motion is applied, and is controlled by the type "B" Ragonnet power reverse gear. Fifty per cent of the weight of the reciprocating parts is balanced.

The frames are of substantial design, the main sections having a width of 5½ in., while the depth over the front driving pedestals is 8½ in., and over the remaining pedestals 7½ in. The top and bottom rails are tied together between adjacent pairs of pedestals, by strong vertical ribs of I-section. These ribs carry the equalizing beam fulcrum pins, which are fitted into case-hardened bushings. Transverse braces are applied at each pair of driving pedestals. Three of these braces—two at the second pair of pedestals and one at the fourth pair—not only brace the pedestals through their entire depth, but are also extended to form long braces for the top rails. They support, respectively, the guide yoke, the valve motion bearer, and a boiler waist sheet.

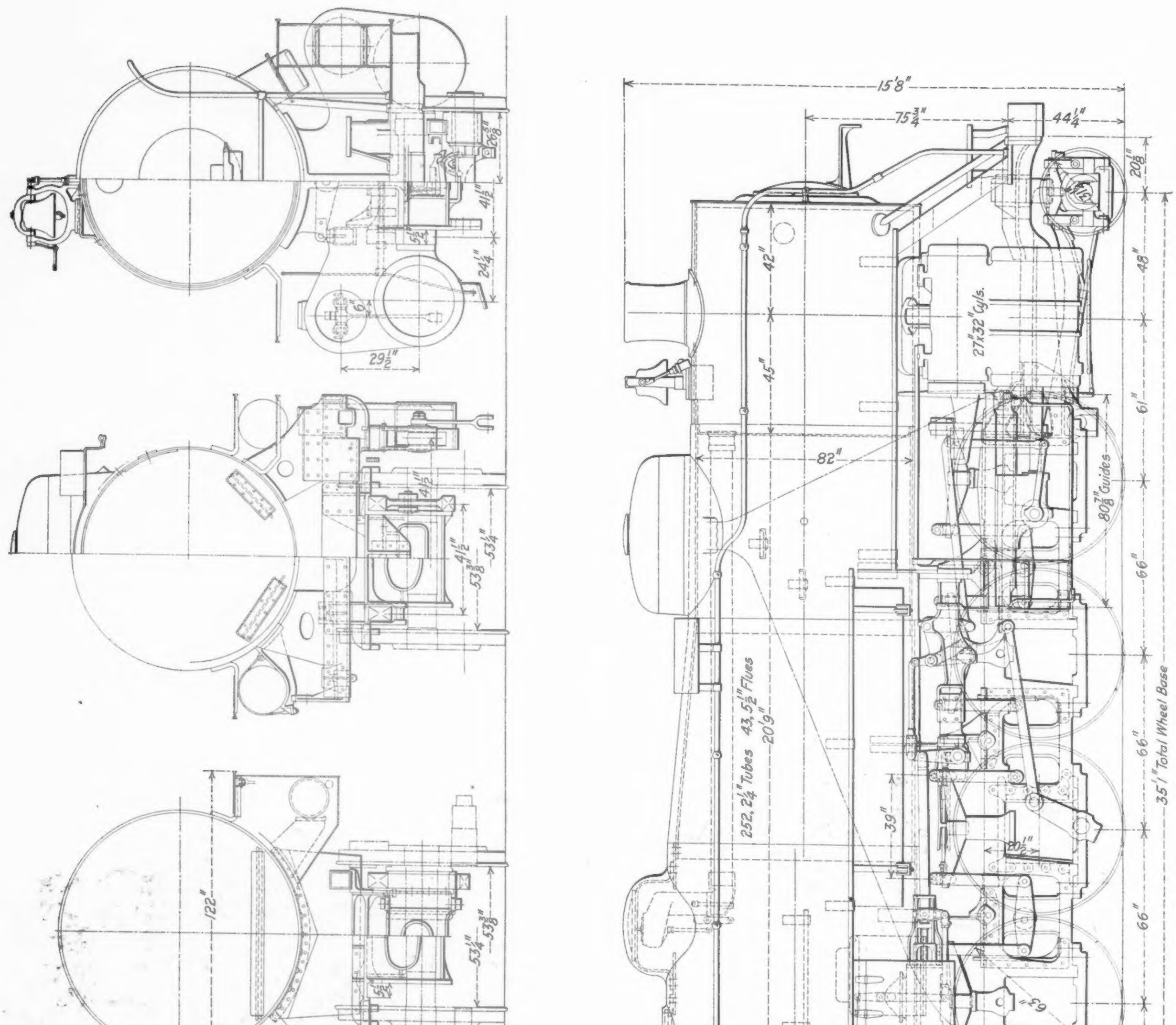
The shoes and wedges are of cast steel, and the driving boxes are of the same material, with brass hub faces. Long main driving boxes are used. The tires are all flanged, and flange oilers are applied to the leading drivers.

The leading truck is of the Economy constant resistance type, and the trailing truck is of the Hodges type. Each truck is equalized with two pairs of driving-wheels. The arrangement of cross equalization frequently applied by the builders, consisting of two transverse beams connected by a central, vertical link, is used between the rear drivers and trailing truck.

The cab is placed well back, thus providing ample deck space. Special attention has been paid to the location of the cab fittings, in order to place all levers, valves, etc., with-



Mikado Type Locomotive Recently Built for the A. T. & S. F.



General Arrangement and Sections of the Atchison, Topeka & Santa Fe Mikado Type Locomotive

in easy reach of the crew, and to locate the steam, air and water gages where they can easily be read.

In accordance with Santa Fe practice, these locomotives are fitted with steam heat equipment so that they can, in cases of emergency, be used on passenger trains.

The tender is carried on two six-wheeled trucks, which are equipped with clasp brakes and Standard rolled steel wheels. The tender frame is of cast steel, in one piece. The buffer between the engine and tender is of the radial type. The Locomotive Stoker Company's slope sheet type of coal pusher is applied.

The leading dimensions are given in the table:

General Data	
Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	59,800 lb.
Weight in working order	314,900 lb.
Weight on drivers	228,900 lb.
Weight on leading truck	31,000 lb.
Weight on trailing truck	55,000 lb.
Weight of engine and tender in working order	563,900 lb.
Wheel base, driving	16 ft. 6 in.
Wheel base, total	35 ft. 1 in.
Wheel base, engine and tender	71 ft. 8⅝ in.
Ratios	
Weight on drivers ÷ tractive effort	3.8
Total weight ÷ tractive effort	5.3
Tractive effort × diam. drivers ÷ equiv. heating surface*	603.4
Equivalent heating surface* ÷ grate area	93.5
Firebox heating surface ÷ equiv. heating surface,* per cent	4.3
Weight on drivers ÷ equivalent heating surface*	36.7
Total weight ÷ equivalent heating surface*	50.4
Volume both cylinders	21.2 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	291.7
Grate area ÷ vol. cylinders	3.2
Cylinders	
Kind	Simple
Diameter and stroke	27 in. by 32 in.
Valves	
Kind	Piston
Diameter	15 in.
Wheels	
Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	12 in. by 20 in.
Driving journals, others, diameter and length	11 in. by 12 in.
Engine truck wheels, diameter	31¼ in.
Engine truck, journals	7 in. by 12 in.
Trailing truck wheels, diameter	40 in.
Trailing truck, journals	9 in. by 14 in.
Boiler	
Style	Wagon top
Working pressure	190 lb. per sq. in.
Outside diameter of first ring	82 in.
Firebox, length and width	114 in. by 84¼ in.
Firebox plates, thickness	Tube, ½ in.; others, ⅜ in.
Firebox, water space	Front, 6 in.; sides, 5 in.; back, 4½ in.
Tubes, number and outside diameter	252—2¼ in.
Flues, number and outside diameter	43—5½ in.
Tubes and flues, length	20 ft. 9 in.
Heating surface, tubes and flues	4,348 sq. ft.
Heating surface, firebox, including arch tubes	266 sq. ft.
Heating surface, total	4,614 sq. ft.
Superheater heating surface	1,086 sq. ft.
Equivalent heating surface*	6,243 sq. ft.
Grate area	66.8 sq. ft.
Tender	
Tank	Water bottom
Frame	Cast steel
Weight	249,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	5½ in. by 10 in.
Water capacity	12,000 gal.
Coal capacity	16 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

One Month of Federal Control

The Director General Appoints Three Regional Directors, a Wage Commission and Other Assistants

Director General of Railways, Wm. G. McAdoo, has spent the month of January in perfecting his organization and in doing his best to help the country's railways in fighting some of the worst weather from the transportation standpoint known for any January in the last 50 years.

Three Divisional Directors Appointed

The dictor general on January 18 issued General Order No. 4 announcing that for purposes of operation the railroads of the United States will be classified as Eastern, Southern and Western Railroads.

A. H. Smith, president of the New York Central, has been appointed regional director, with office at New York, in charge of the operation of Eastern railroads.

C. H. Markham, president of the Illinois Central, has been appointed regional director, with office at Atlanta, in charge of the operation of Southern railroads.

R. H. Aishton, president of the Chicago & North Western, has been appointed regional director, with office at Chicago, in charge of the operation of Western railroads.

Orders issued by the gentlemen named in their capacity as regional directors will be issued by authority of the director general and will be respected accordingly.

Railroad Wage Commission

In his next order, General Order No. 5, Mr. McAdoo announced the appointment of a Railroad Wage Commission to make a general investigation of the subject of railroad wages in the United States. The members of the commission are Franklin K. Lane, Secretary of the Interior, Charles C. McChord, member of the Interstate Commerce Commission, J. Harry Covington, chief justice of the supreme court of the district of Columbia, and William R. Willcox of New York. The members of this commission are all men who have had experience in dealing with problems like that referred to it.

The commission held its first meeting at Washington on January 21 and organized by electing Secretary Lane as chairman. W. A. Ryan was appointed secretary of the commission. It was decided to appoint a board of four examiners and a statistical board of three members. Public hearings will be held at Washington and it was stated that some results could be expected in about 60 days.

The commission has established itself in offices in the Department of the Interior building. F. W. Lehmann has been appointed general counsel and a board of statisticians has been appointed consisting of Charles P. Neill, manager of the Bureau of Information of the Southeastern Railroads and formerly United States Commissioner of Labor; F. A. Burgess, assistant grand chief of the Brotherhood of Locomotive Engineers; and A. O. Wharton, who is president of the Railroad Department of the American Federation of Labor.

A tentative program of hearings has been outlined, at which the following labor leaders will be heard: T. H. Garvey, representing maintenance of way employees; E. H. Norton, representing the Order of Railway Station Agents; W. G. Lee, president of the Brotherhood of Railroad Trainmen; A. B. Garretson, president of the Order of Railway Conductors; S. E. Heberling, president of the Switchmen's Union; W. S. Carter, representing the Brotherhood of Locomotive Firemen and Enginemen; and A. O. Wharton, representing the mechanical employees, helpers and apprentices

and railway clerks. It is understood that railroad officers will also be heard.

The commission is acting under the authority of General Order No. 5, issued by the Director General, which provides that:

"The commission shall make a general investigation of the compensation of persons in the railroad service, the relation of railroad wages to wages in other industries, the conditions respecting wages in different parts of the country, the special emergency respecting wages which exists at this time owing to war conditions and the high cost of living, as well as the relation between different classes of railroad labor.

"The commission shall begin its labors at once, and make report to the Director General, giving its recommendations in general terms as to changes in existing compensations that should be made.

"Officers, agents and employees of the railroads are directed to furnish to the Railroad Wage Commission upon request all information it may require in the course of its investigations."

ECONOMY IN EXPENDITURES

The director general on January 28 issued his first order looking toward economy in the expenditure of railroad operating revenues during the period of the war. This was General Order No. 6, issued to officers and directors of railroad companies, as follows:

"During the period of possession, operation, and government control of railroads, it is necessary that officers, directors, and agents of railroad companies be very careful in the handling of moneys and in the dealing with transportation matters. Without attempting at this time to give general directions, there are a few matters involving the expenditure of moneys for purposes having no direct relation to transportation, which should receive immediate attention; as well as the issuance of free transportation.

"It is therefore ordered that the carriers' operating revenues shall not be expended:

"1. For the payment of agents or other persons who are employed in any way to affect legislation.

"2. For the employment of attorneys who are not actually engaged in the performance of necessary legal work for the company.

"3. For the payment of the expenses of persons or agencies constituting associations of carriers unless such association is approved in advance by the Director General.

"4. For any political purpose or to directly or indirectly influence the election of any person or an election affecting any public measure.

"No passes or free transportation shall be issued by any carrier under federal control or any official of such carrier unless the issuance of such free transportation is expressly authorized by the Act of Congress entitled 'An Act to Regulate Commerce, approved February 4, 1887, and Amendments thereto'; and any such passes or free transportation heretofore issued not in conformity with said act must be recalled.

"This order applies to all carriers under federal control, whether inter-state or intra-state."

The order as it applies to passes simply extends the provisions of the federal law to cover intra-state as well as interstate transportation. Some states have no anti-pass laws and the laws in many states are more liberal than the federal law, many of them allowing or even requiring railroads to give free transportation to public officials.

ALL NEW LOCOMOTIVES FOR EASTERN LINES

One of the most important matters that has come before the director general has been that of motive power. The eastern roads are now using some 100 Consolidation locomotives built for the American railway lines in France; during the last few weeks the larger part of the 165 locomotives on western roads ordered sent to the more congested eastern roads have been so diverted; steps are being taken to secure some 200 locomotives intended for Russia, but most important of all is the order of the director general that the locomotive builders should deliver to specified eastern lines all the locomotives turned out in January, February and March, regardless of the roads that ordered them. About 150 are to be delivered in January, about 250 in February and 250 in March.

Mr. McAdoo has been in conference with officers of the locomotive companies in the effort to secure early delivery of engines which have been ordered and in making arrangements for obtaining the use of locomotives ordered by the Russian government. As one of the great sources of difficulty has been the shortage of labor for repairing locomotives, efforts have been made to transfer men from the western and southern lines to the eastern lines.

Bearing upon this locomotive situation and upon the weather conditions is the statement issued by Commissioner McChord on January 29 summarizing reports of the Interstate Commerce Commission's inspectors relative to the congestion of freight traffic on the Pennsylvania Railroad:

"A condition of serious congestion exists on the Pennsylvania Railroad in the Philadelphia district and in the Pittsburgh district and the line between is practically blocked with cars destined for those two points and beyond.

"In the Philadelphia yards the normal daily movement of cars is 2,925. The reports covering the period from January 14 to January 25, inclusive, except for January 19 for which no report was furnished, show that the maximum daily movement was 2,210 cars, and the average was less than 2,000. And on these same dates there were from 54 to 61 trains left over in the Philadelphia yards ready for movement but for which no locomotives were available. The number of cars left in the yards varied from 3,825 to 5,750. During this entire period there were from 1,400 to 2,200 empty coal cars in the yard for movement westward, and the number actually forwarded westward varied from 119 to 585 per day.

"On the Middle division, for movement in both directions, there were approximately 11,000 cars left over each day. While at times the business accepted by the Philadelphia and the Pittsburgh divisions was restricted, the traffic handled when not restricted by connecting divisions frequently did not exceed 50 or 60 per cent of the normal business.

"In the Pittsburgh district, the average number of trains for which no locomotives were available in Pitcairn and Conway yards was more than 100 trains daily, and there were approximately 10,000 cars left over in those two yards each day.

"For four days on which the information was furnished, coal mines in the Pitcairn district were supplied with a very small percentage of empties required, in one instance 324 cars being required and only 24 furnished on account of no other empties being available.

"The principal cause assigned for the serious congestion on this railroad is shortage of motive power, but it is clearly apparent that the real cause is the impaired condition of motive power available, as well as the lack of adequate facilities for properly maintaining it, and excessive terminal delays. For example, the inspector reports that the facilities for maintaining the 149 locomotives assigned to Pitcairn are entirely inadequate, and only such repairs as are absolutely required are made, the demand for power being so great that minor repairs and other work which would greatly increase efficiency of locomotives are left undone; further, that even if more locomotives were assigned there, it is doubtful if they could be properly maintained or promptly handled. And at Altoona, on January 23, the report for that

date being typical, all of the 50 stalls of the engine-house were occupied by locomotives undergoing repairs, 190 of the 230 locomotives despatched were repaired on inspection pit and storage tracks where there was no shelter or protection from snow and weather. Under such conditions, and in the crowded and unheated enginehouses existing at many points, some of which are too small to accommodate the large locomotives in use today, it is not reasonable to expect that necessary work can be promptly and efficiently performed. Vigorous action must be taken to improve the condition of motive power before relief can be expected."

BLIZZARDS HANDICAP RAILROADS

Storms and continued cold weather together have made the month just past the worst January from the railroad standpoint in 50 years. The weather has prevented the realization of the relief that was hoped from the five-day closing down of industry and because of it "freight moving week" was far below expectations. Serious storms were met both in New York and Chicago; and along the Ohio river and in eastern Kentucky floods, floating ice and wash-outs are causing considerable damage.

The succession of blizzards and low temperatures has made it impossible to raise the embargo against general freight ordered on January 23 on the Pennsylvania, Baltimore & Ohio and Philadelphia & Reading, which it was expected would be in force but a few days. While one of the most serious conditions, the inability of ships to embark, because of the delay in obtaining bunker coal, has been remedied, many of the eastern roads have been unable to handle much new freight except food, fuel and necessary government freight for several days and most of the reports received at Mr. McAdoo's office have been discouraging, while the daily reports of the Interstate Commerce Commission's inspectors from various terminal points, received by Commissioner McChord, continue to show conditions approaching a paralysis of transportation at many points, due to weather conditions, congestion in yards, shortage of crews, and engines and cars in bad order with a shortage of labor to repair them.

A. H. Smith, regional director in charge of the eastern lines, reported on January 26 that it had been necessary to suspend operations in Northern New York on account of a heavy snow storm and that on account of a very severe snow storm at Chicago all belt roads had discontinued accepting cars. Assurances that an adequate supply of cars will be furnished for the transportation of food supplies for export to the allies was given by Director General McAdoo at a conference with commissioners representing the British, French and Italian governments on Saturday and some discussion was given to the question of diverting more export freight to gulf ports.

Director General McAdoo has instructed, in the matter of embargo on the Pennsylvania Lines east of Pittsburgh, Baltimore & Ohio east of the Ohio River, and Philadelphia & Reading, that the following exceptions be made:

(a) Food for animals.

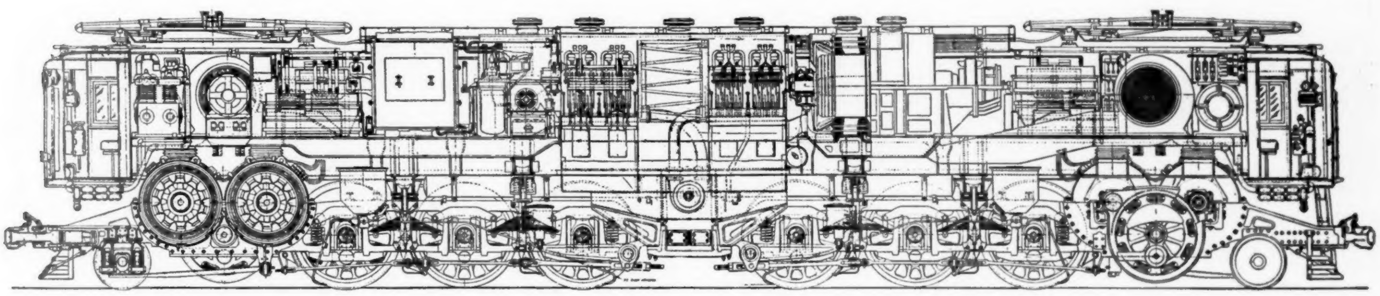
(b) Material used in the operation and upkeep of coal mines.

To provide for the rail movement of food and supplies consigned to the French, British and Italian governments, for ports on the North Atlantic seaboard, already accepted or under permit, arrangements have been made to consolidate these shipments and move them in solid trains, or groups of cars, east from Chicago, St. Louis and intermediate terminals.

PENNSYLVANIA ELECTRIC LOCOMOTIVE

A Description of Interesting Details in the Running Gear Construction and in the Electrical Equipment

TESTS have recently been made on the Philadelphia-Paoli electrified section of the main line of the Pennsylvania Railroad, of the experimental electric locomotive which has been built for main line freight service by the Pennsylvania Railroad and the Westinghouse Electric & Manufacturing Company. A brief description of this locomotive, including the principal dimensions, was published in the July issue of the *Railway Mechanical Engineer*, page 379. It is the largest electric locomotive which has so far been built, having a starting tractive effort of 130,000 lb. and a total weight of 240 tons, of which 198 tons is carried on the drivers.



Longitudinal Section of the Pennsylvania Electric Locomotive

The locomotive has a nominal one hour rating of 4,800 hp. at 20.8 miles an hour, which is equivalent to a tractive effort of approximately 87,000 lb. The continuous rating is 4,000 hp. or 72,000 lb. tractive effort at a speed of 20.85 miles an hour, with the motors connected in parallel. For starting and slow speed operation, a "cascade" connection of the two motors on each truck unit is provided. When regenerating at continuous capacity, the locomotive is capable of returning to the trolley system 4,400 hp. at a speed of 21 miles an hour.

In service between Altoona and Johnstown, where it is the intention eventually to use locomotives of this type, it is proposed to operate trains with one locomotive at the head end and one pushing. The continuous capacity at a speed of 20.85 miles an hour enables a trailing load of 2,300 tons to be hauled up a one per cent grade, 4,100 tons up a .5 per

cent grade, or 11,000 tons on level track. Two locomotives operating under the proposed plan are expected to handle 3,900 tons westbound, where the ruling grade is 2 per cent, and to handle 6,300 tons eastbound over a ruling grade of 1.33 per cent. The speed chosen is considered to be about the maximum desirable for the operation contemplated and is governed by the size of trains as well as the characteristics of profile and alinement.

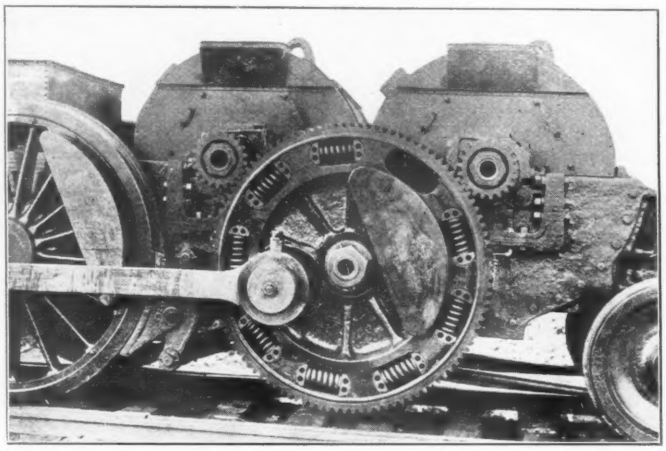
In the previous article was given a general description of the construction of the locomotive, but there are a number of features of the locomotive, both mechanical and electrical, which are worthy of more detailed consideration.

The method of securing a rigidly maintained gear center distance may be seen in the illustration showing the flexible jack shaft gear and motor pinions with the casing removed. The jack shaft bearing brass consists of a solid bronze bushing pressed into an eye in the side frame. The removal of this brass involves the removal of the main gear center from the jack shaft. The armature bearings are contained in housings which are fitted into pockets 27 in. wide by 14⅜ in. deep in the top of the frame casting. These pockets depart from the rectangular in that the sides are tapered 1 in. in 16 in., the housing being forced into the pockets under a pressure sufficient to produce local stresses in excess of any that will be imposed in service. The housings are then bolted in place both horizontally and vertically. The center distances between the gear and the motor pinions are, therefore, as securely fixed as if all three bearings were in an integral casting.

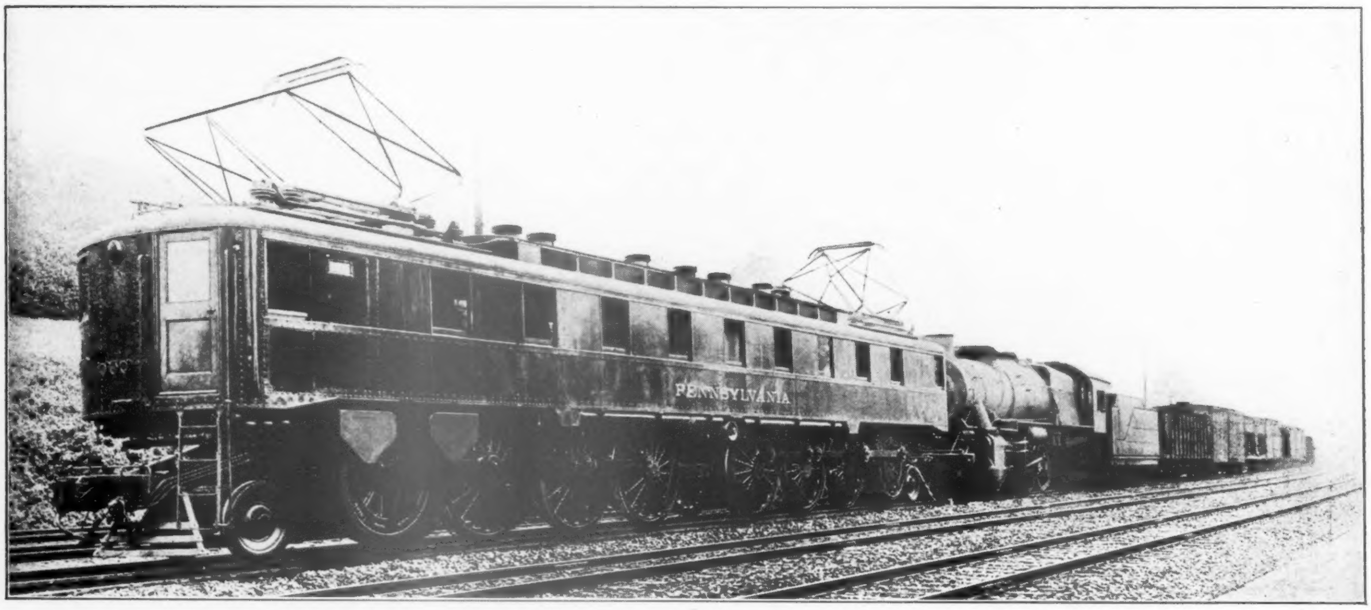
The active iron of both motor stators on each truck is mounted in a unit motor frame and locomotive cross-tie casting, which also surrounds the jack shaft. The armature bearings are arranged for oil ring lubrication, while the jack shaft is fitted with oil and waste lubrication, a large waste cavity being provided in the side frame casting above the jack shaft bearing.

The body of the jack shaft is 11⅛ in. in diameter with a long taper on each end to receive the gear center. The shaft is hollow, a hole 3 in. in diameter extending through from end to end. The gear center is of cast steel with a long hub which extends through the bearing brass and forms the running surface of the journal. The bore of the gear is tapered throughout its length and fits the taper on the end of the jack shaft. The gear center is pulled home to its seat on the shaft by a heavy nut on the end of the shaft, which is located in a counterbore in the outer face of the gear center. A heavy key in the taper fit insures the proper quarter of the crank pin. The crank pin is 8¼ in. in diameter and has a throw of 30 in. Opposite its center is a lead filled counterbalance with proper angular offset to compensate for transverse unbalance. A complete counterbalance is thus secured for all operating speeds.

The flexible gear is of the Westinghouse type which was developed for railroad service and has previously received wide application both on cars and locomotives. This, however, is the first commercial application in connection with rod drive and no other railroad application approaches it in the amount of power transmitted. The gear has a face 10 in. in width which is a radical departure from previous railroad practice with overhung gearing. This width is made practicable by dividing the gear rim at its midwidth into two rings, independent flexibility being provided for each ring relative to the gear center. The gear pinions are integral and each meshes with both rings, the independent flexibility of which insures an approximately equal division of the maximum load. The pinions and gear rims were manufactured by the R. D. Nuttall Company and are of heat treated steel.



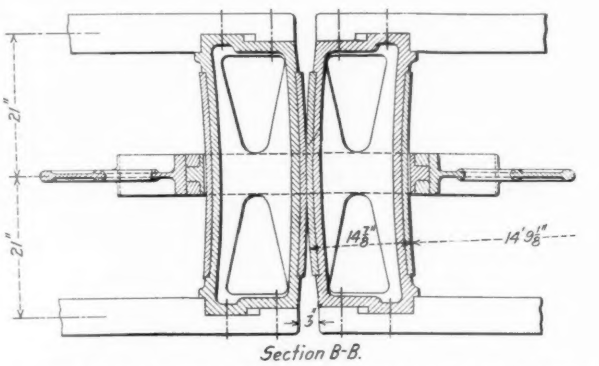
Motor and Jack Shaft Mounting



Pennsylvania Electric Locomotive Hauling an Idle Steam Locomotive and Freight Train

The foundation of the cab structure consists of two built-up Z-shaped girders 26 in. deep, which are spaced 6 ft. 1⅛

in. apart. To the top of these girders is riveted a cover plate upon which the electrical apparatus is secured. At the mid-length of the cab is a built-in well 15 in. deep by about 3 ft. in width, containing the electrolyte supply from the liquid rheostat, the sides of which are supported from the center girder. To the bottom of this tank is secured the articulating device, which is of unique construction; in effect it is a link by means of which the inner bumper beams of the two truck units are held in contact, and by means of which all



Section Plan of the Curved Bumper Castings and Articulating Link

traction stresses are transmitted from the frames of one truck unit to those of the other through the bumper beams, without imposing any stresses upon the cab structure other than those due to its own inertia.

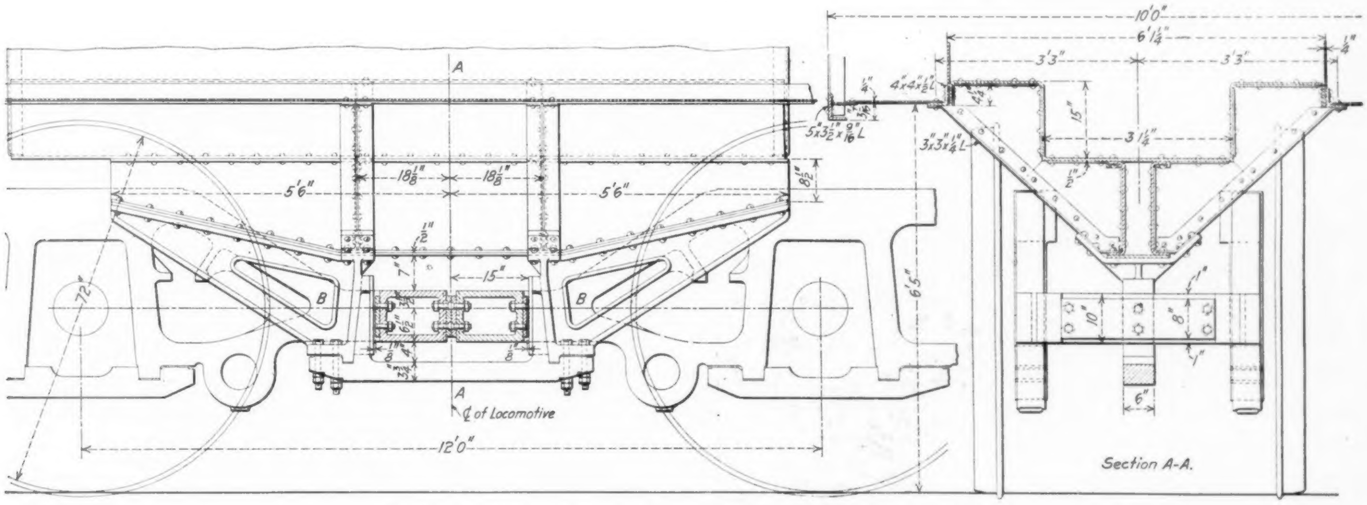
The inner bumper beam of each truck unit is a steel casting of box section, the vertical faces of which are circular arcs with radii equal to the distances from the center of the cab center pin bearing. The two castings are thus in rolling contact with each other as the angularity of the center lines of the two trucks changes, due to track curvature. Supported from the bottom of the electrolyte well by means of pressed steel channels are two steel castings, each of which forms one jaw of a longitudinal pedestal spanning the two bumper beams. This pedestal is closed by a binder generally similar to the usual type of locomotive driving box pedestal binder. The faces of the cast steel jaws are tapered and are covered by long vertical extensions on the binder to which are bolted steel wearing plates. When the locomotive is in operation the inner face of each bumper beam is in sliding contact with one of these plates. Both the inner and outer surfaces of the steel bumper beams are protected by steel wearing plates one inch thick, and held in place by countersunk bolts.

The longitudinal cross section of the locomotive shows in detail the arrangement of the apparatus in the cab. Single-phase current at a potential of 11,000 volts is collected by a pantagraph trolley, thence following a path through an oil circuit breaker to the primary of the transformer from which it is led to the framework of the locomotive, the circuit being completed through the rails to the substation. The secondary of the transformer supplies power to the phase converter, which may be considered as a combined motor generator, transposing a portion of the power to a phase displacement of 90 deg. from that of the transformer secondary voltage. This, together with the direct supply from the secondary of the transformer, forms a two-phase source of power which is combined by means of a Scott connection to give virtually three-phase energy.

A small single-phase motor which is mounted on the shaft of the phase converter is used in starting to bring the phase converter up to synchronous speed. It is then automatically cut out and used as a direct current generator to excite a winding on the rotor of the phase converter, to obtain a power factor of unity.

A series of taps is used on the main transformer partly to regulate the drop in the secondary voltage of the phase converter through its impedance when operating under heavy loads, and the rise in voltage when regenerating; also to correct the distortion of the phase of the secondary voltage under varying loads. Electro-pneumatically operated unit switches are used to change the various taps on the transformer in such a way as to enable the change to be made from one tap to another without disconnecting the phase converter from the secondary of the transformer, or momentarily short circuiting the transformer coils.

Three-phase power is supplied to each of the four motors through a set of five electro-pneumatically operated unit switches. These motor primary switches are also used as reversing switches. One is used commonly for both forward and reverse operation, and the other four switches are used in pairs to interchange the connection of two of the phases for obtaining forward or reverse rotation of the motors.



The Articulating Device—Pennsylvania Electric Locomotive

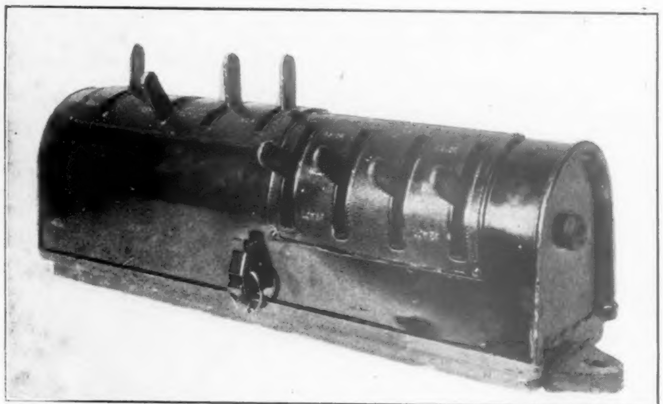
The motors are arranged for two-speed combinations, or normal regenerating positions, corresponding to approximately 10 and 20 miles per hour. On the low speed, each pair of motors is connected in cascade; on the high speed, the motor primaries are connected to the three-phase supply in parallel, each secondary being connected to a regulating liquid rheostat. The control is arranged so that the change from one speed to another is made without losing more than half the accelerating or regenerating torque, this being accomplished by a progressive transition of the pairs of motors.

The liquid rheostats, which govern the acceleration of the

driving motors, are located in two separate tanks, the castings of which are built as a part of the cab frame. Each tank contains two sets of electrodes. The liquid is circulated continuously through each of the tanks by centrifugal pumps. The level of the liquid in each tank may be varied independently by means of tubular overflow valves, which are controlled by differential air engines of the Westinghouse PK type. The rheostats are located in the center of the locomotive, one pair at each end of a cooling tower compartment containing two cooling towers. A small percentage of the liquid is by-passed to the top of the cooling towers and flows over the surface of the cooling trays back into the main tank. Air is blown over the trays in a direction opposite to that of the liquid. In this way the body of the electrolyte in the main supply tank is sufficiently cooled by the expenditure of a relatively small amount of energy for pump operation, and the sacrifice of but a small quantity of electrolyte through evaporation.

When the liquid level in the rheostats has reached its maximum height, which occurs when the overflow valves occupy their uppermost position, a set of switches is automatically closed to short circuit the secondary motor winding and cut out the rheostats. A small motor generator set, the motor of which is of the three-phase induction type, provides a source of direct current for energizing the field of the phase-converter motor when it is operating as a direct-current generator to excite the phase converter motor winding. Power to operate the control circuits and marker lights is also obtained from this set.

One of the illustrations shows the master controller with the case removed. The upper handle, which is designated the "speed" handle, has three positions, one each for the 10 and 20 mile per hour combinations, and one midway between these two which is used as the transition position to enable one pair of motors to be changed over to a new combination without losing the accelerating or regenerating torque of the other pair. The center handle on the master controller controls the acceleration of the locomotive. It has three positions, marked "raise," "hold" and "lower." A movement of the handle to the "raise" position and then



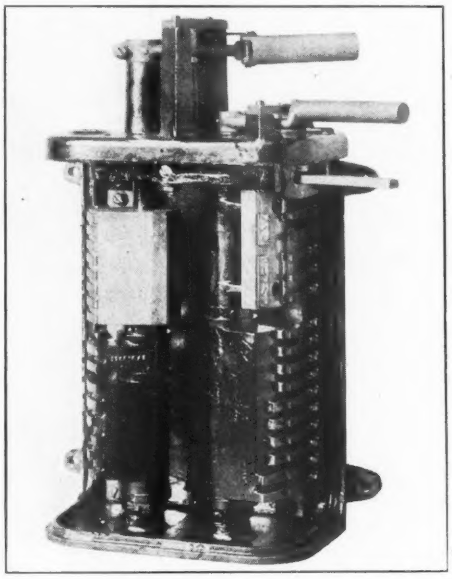
The Auxiliary Controller

back to the "hold" position gives a positive increment of rise in the liquid level of the rheostats. Moving the lever to the lower position and then back to the hold position results in a lowering of the level of the liquid in the rheostats. In this way the speed of the locomotive is controlled during either the cascade or parallel connections.

Overload protection is obtained by a current limit relay. This has the advantage of not opening the circuit, but operates first to arrest the rise of the liquid level in the rheostats and then to lower the level if the accelerating current goes beyond a certain fixed maximum value.

The liquid rheostats may be operated independently of each other by means of levers located in an auxiliary controller. This provides a means of equalizing the load on the different pairs of motors and of reducing the current supply to one pair, without affecting the other pair. Other levers are provided in the auxiliary controller for raising and lowering the trolley, starting and cutting out the phase converter, and operating the phase converter voltage and phase balancing switches.

Due to the inherent characteristics of the induction motor regeneration requires no extra control equipment. Manipulation of the master controller is exactly the same for re-



Master Controller with Case Removed

generation as it is for running. The manipulation of this type of locomotive is extremely simple for both running and braking, requiring no special knowledge other than the manipulation of the air brakes when handling heavy trains.

There are two compressor sets on the locomotive, each a four-cylinder, two-stage balanced compressor having a capacity of 150 cu. ft. These are manufactured by the Westinghouse Air Brake Company. The armature of the motor is fitted on the overhung shaft of the compressor. The motor is a Westinghouse four-pole commutator type for alternating current, and at 150 volts on each circuit develops 35 hp. continuous rating at 1,200 r.p.m. By making use of a single-phase commutator motor, the compressor set can be operated independently of the phase converter, the only other apparatus needed being the transformer. This motor has characteristics similar to a series motor and gives a high torque at starting. The compressor sets are controlled automatically by electro-pneumatic governors.

There are two sets of motor driven blowers on the locomotive. These blowers force air through ducts to the main motors, phase converter and main transformer. They are mounted one at each end of the cab. In the event of failure of one set, the air ducts and dampers are so arranged as to supply air to all the apparatus in the cab from the other set. This feature also makes it possible to shut down one blower set while switching, and also to reduce stand-by losses. Although normally operating three-phase, the blower motor will run single-phase and act as a phase converter for the circulating pump motors. After a run, the phase converter may therefore be shut down and the blower motors will continue to run on single phase after having been brought up to speed on three-phase while the phase converter was in operation. This makes possible a further reduction in stand-by losses.

REINFORCING WOODEN FURNITURE CARS

At the time when the wooden car represented the standard type of construction, many railroads had built a large number of furniture cars and vehicle cars which were designed to give the greatest cubical capacity which the clearance limits would permit. In order to bring the floor to the lowest possible level, special types of bolsters were used and the sills were brought down in line with the couplers. There are many cars of this type still in use and even though their construction is such that the cost of maintenance is abnormally high, under the present conditions the cars must be kept in service. Many roads are therefore considering methods of reinforcing such cars to make them fit to stand hard service.

The Chicago, Rock Island & Pacific has recently applied underframe reinforcing to a large number of furniture cars of this type. Since the design presents certain problems not encountered in designing reinforcing for cars having the line of draft below the sills a description of the method used may be of interest.

It was evident that the prime requisite of the reinforcing was a construction that would provide a proper attachment for the draft gear and would be capable of withstanding severe shocks. Three types of reinforcing were considered:

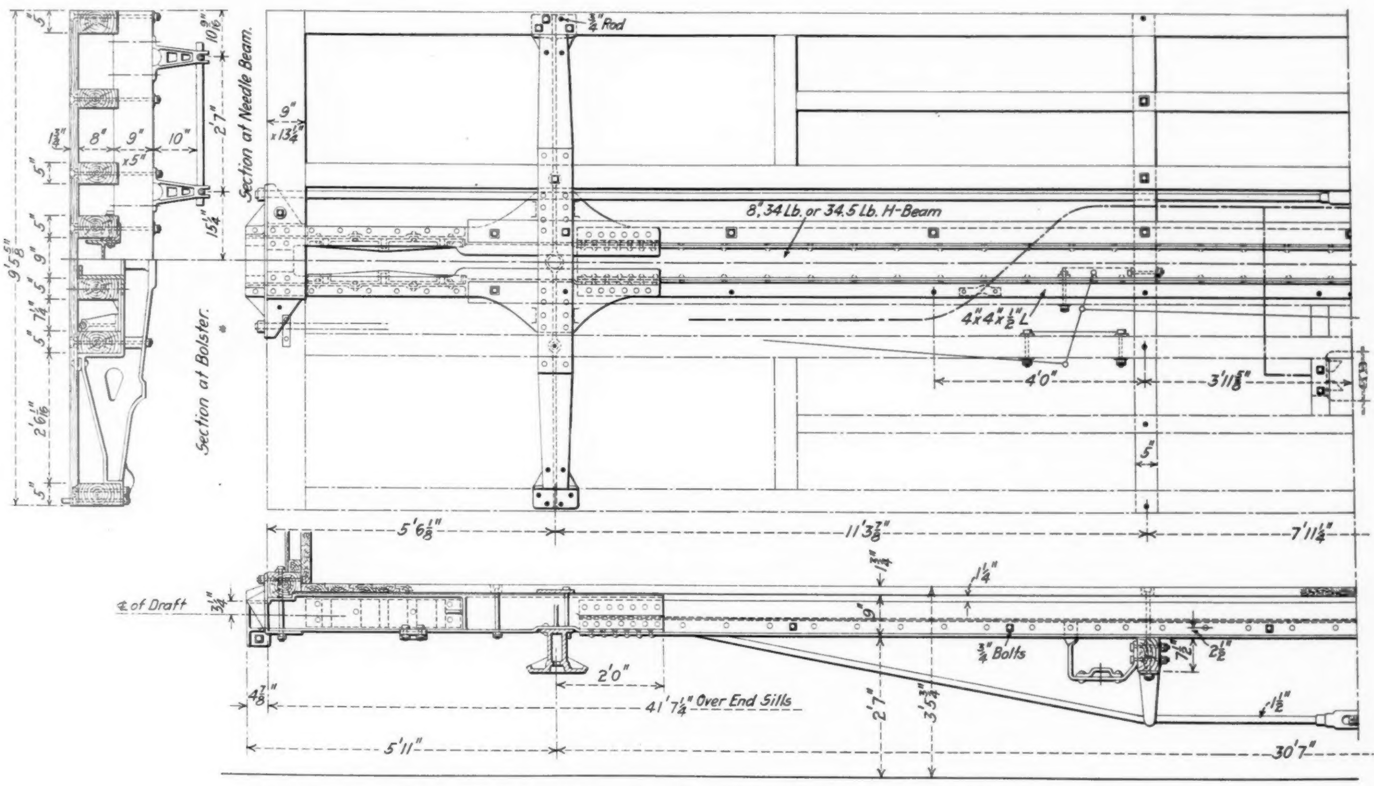
(1) A complete steel underframe carrying the vertical load due to the weight of the car and the lading, as well as the buffing and pulling stresses.

(2) A steel draft member extending the full length of the car designed only to take the buffing and pulling stresses, the vertical load being carried on truss rods.

(3) Steel draft members extending from the end sill to the bolster, or a short distance beyond, and secured to the bolsters and also to the center sill.

The application of a complete underframe would have made it necessary to raise the floor level to an unusual height and the short steel draft arm would have been difficult to attach to the bolster in the proper manner. For that reason it was decided to use a design of the second type.

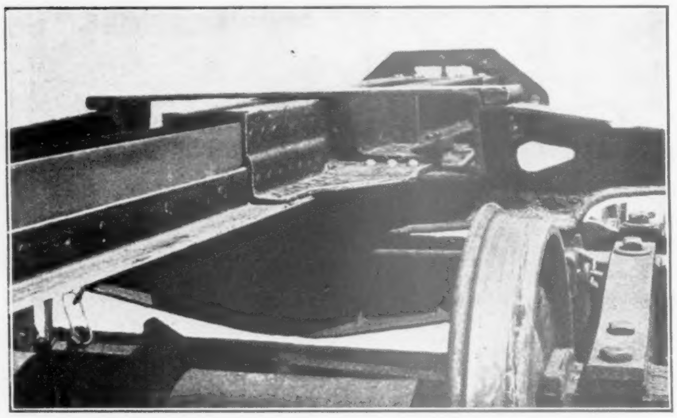
It was necessary to have the main member placed between the two center sills, which were 9 in. apart. The construction finally chosen consisted of an 8-in. 34-lb. H-beam, with the flanges vertical, reinforced at the lower edges by two 4-in. by 4-in. by $\frac{1}{2}$-in. angles. The rivets joining the angles and the H-beam were countersunk in the flanges of the angles so that the assembled member would fit between the sills. The sills rest on the angles when the underframe



Underframe Reinforcing for Wooden Furniture Cars With Sills on the Line of Draft As Used on the Chicago, Rock Island & Pacific

is in position and are fastened to it by bolts placed both vertically and horizontally.

A cast steel draft member extends from the bolster to the end of the car. It is fastened to the center member by rivets through both the vertical and horizontal flanges and



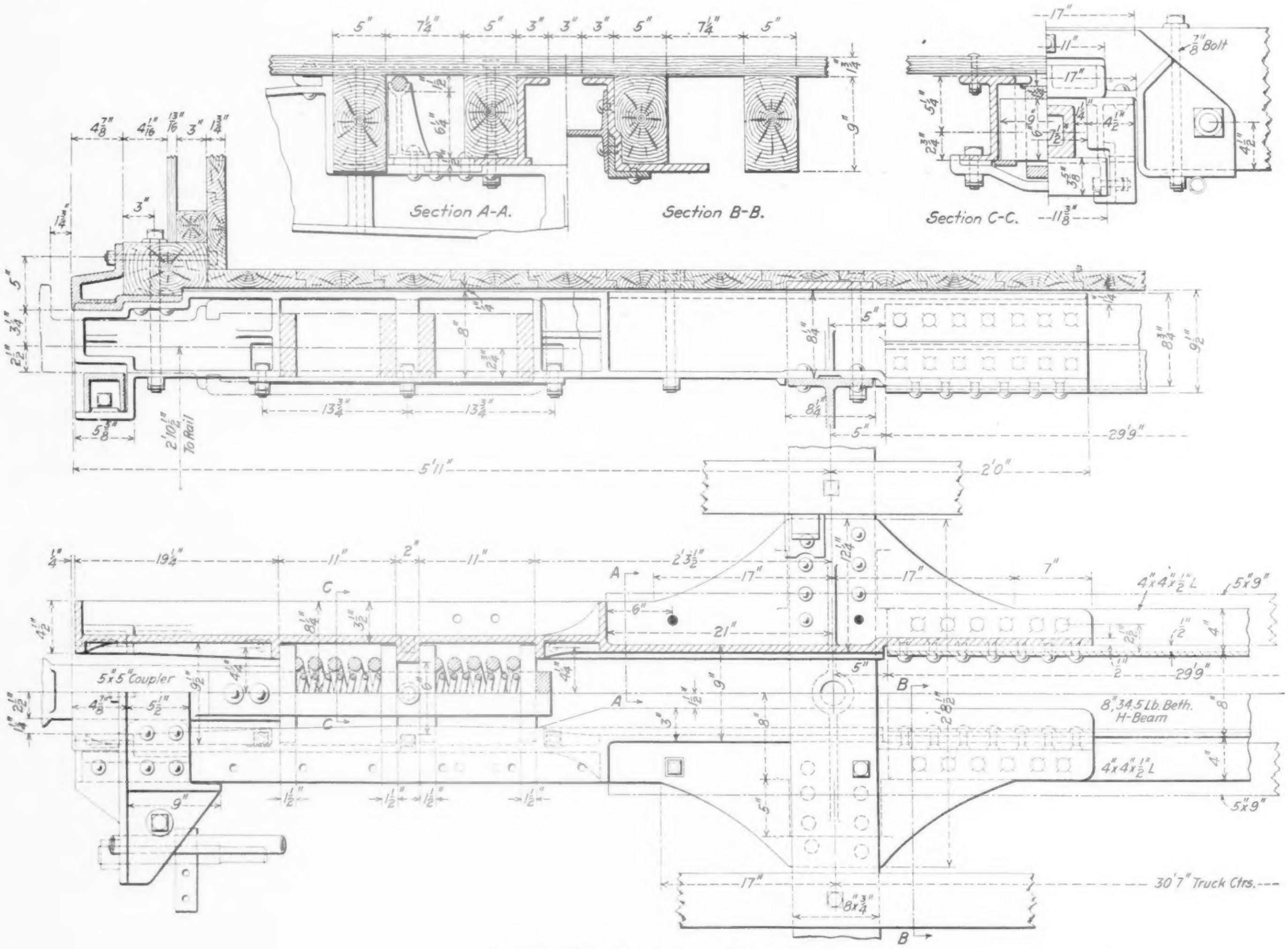
Draft Arm and Bolster Used With Girder Beam Underframe

is also riveted to the top flanges of the bolster. The drawings show clearly how well this arrangement adapts itself to the reinforcing of cars having the cut-out tie-plate type

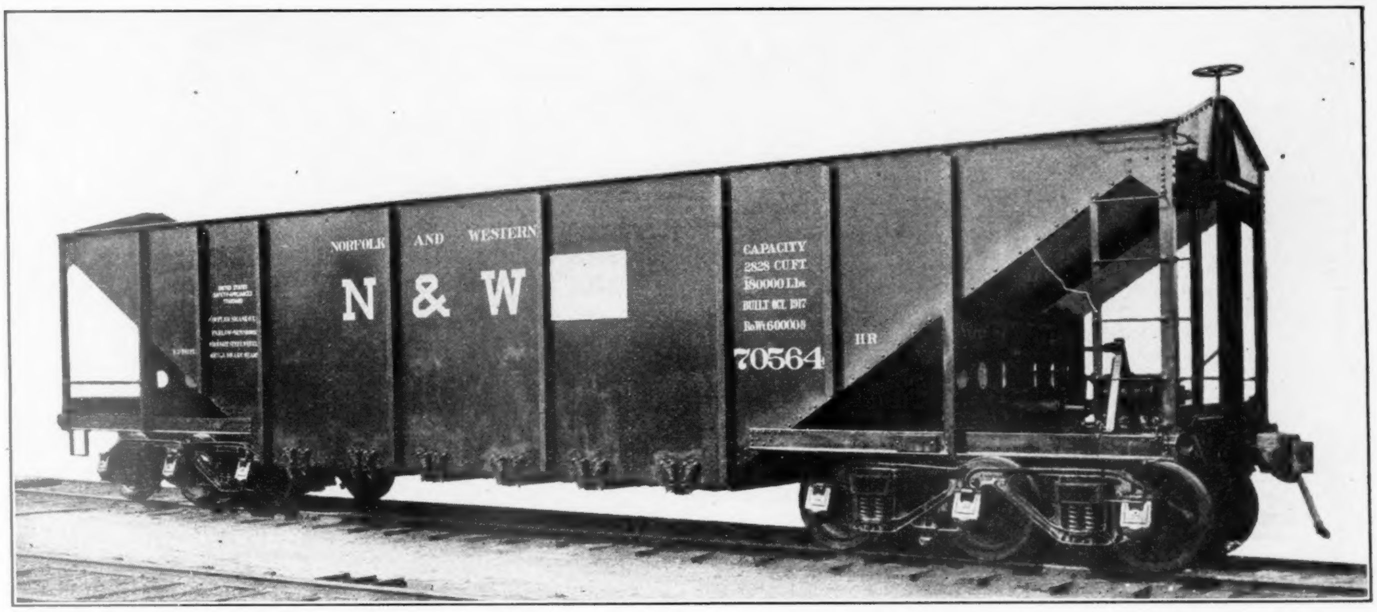
of bolster and sills on the line of draft. The building of the reinforcing requires a comparatively small amount of labor and the application is very easy as the main member can be jacked directly into position between the sills.

This type of center sill member has been found to meet all requirements on cars in regular freight service and the cost of construction and application has proven much lower than other types which have been tried. A similar design has been used on cars having the sills above the line of draft, which involves the use of a draft plate below the H-beam, instead of cast steel end members, for the attachment of the draft gear. Both designs are covered by patents issued to E. G. Chenoweth, J. J. Acker and G. A. Hull, all of the Rock Island.

Siberian Railroad One-Third Efficient.—Inefficient transportation service by the Trans-Siberian Railroad is responsible for an immense congestion of traffic at Vladivostok, was the statement of S. R. Bertron, a member of the American Commission to Russia, at the second conference of the Russian-American Chamber of Commerce held recently in New York. "The Trans-Siberian Railroad is only giving about thirty per cent efficiency," Mr. Bertron said. "On the books of the line are double the number of locomotives the Pennsylvania Railroad has per mile. There are three times as many men employed on the Trans-Siberian Railroad as the Pennsylvania has, and yet the efficiency is only thirty per cent. It is expected that our government will be able to introduce a total of 75 locomotives and 1,000 cars in Russia during the present year, but this is only a small fraction of what Russia requires in the way of railroad equipment. [Press despatches October 16 said that the Stevens Commission had improved the situation at Vladivostok, increasing the efficiency of the railroad 25 per cent.]



Details of Draft Arm and Bolster



A 100-Ton Coal Car for the N. & W.

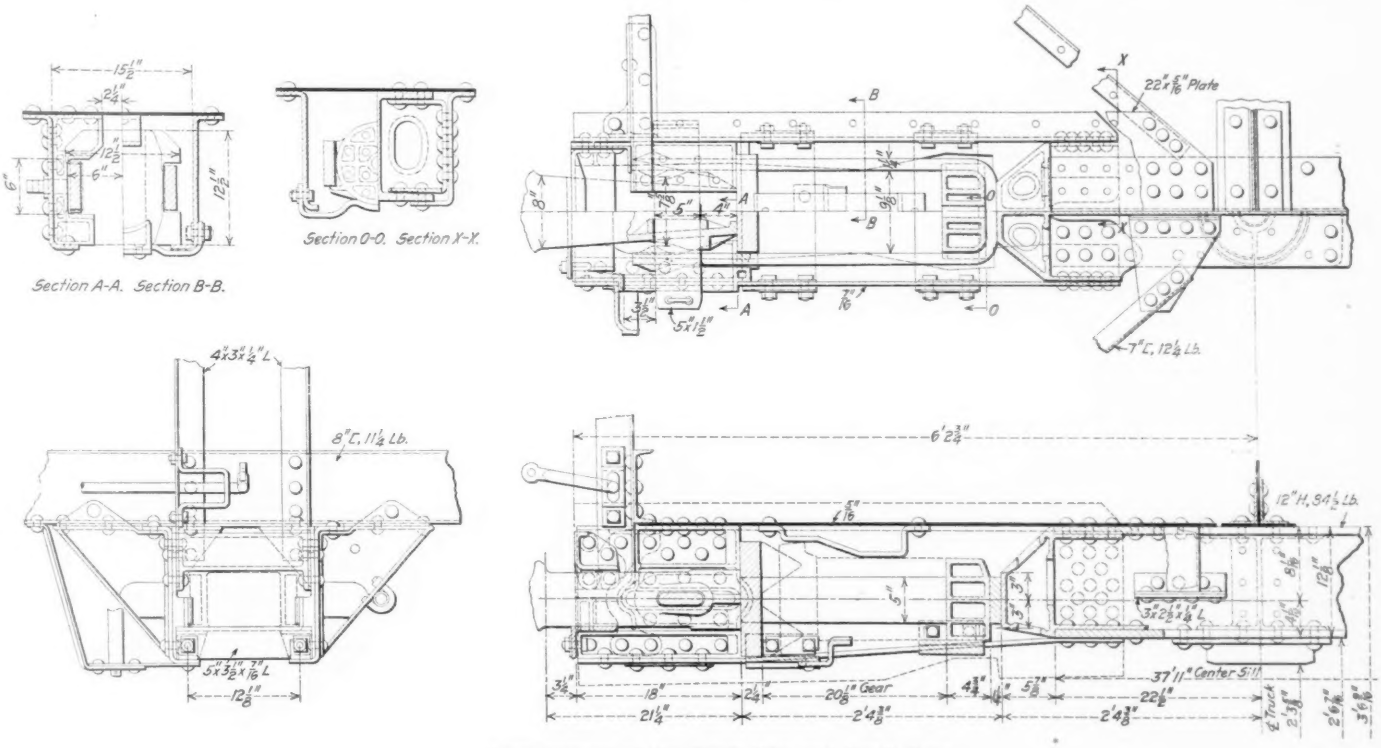
Single Member H-Section Center Sills; Load Carried to Car Sides by Transverse Plate Girders

BY B. W. KADEL

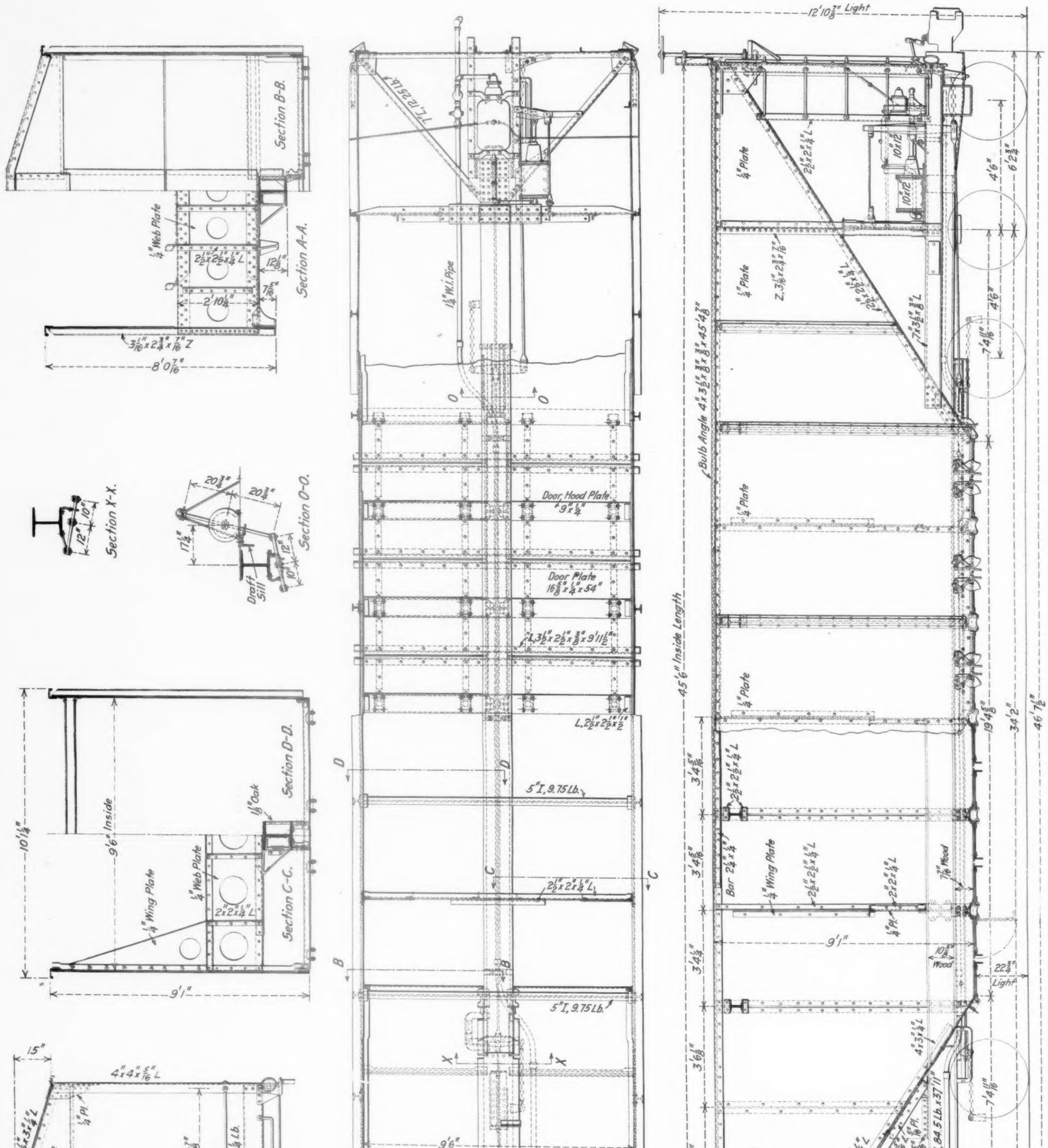
THE Norfolk & Western recently built at its Roanoke Shops and put into service a 100-ton self-cleaning hopper car, of all-steel construction, using six-wheel trucks. This car, known as the class HR, has been built as a sample car the service results of which will determine the advisability of providing larger quantities of this type for this service.

The design of the car follows previous designs of Norfolk & Western hopper-bottom cars in that the drop doors are arranged in pairs extending across the car from side to side. Six pairs of doors are used, giving a door opening approximately 19 ft. 6 in. long. Each pair of doors may be dropped independently of the others.

The center sill of the car is composed of a Bethlehem 12-in., 84½-lb. H-section and extends slightly beyond the bolsters at each end of the car, where it is milled off to exact length and a true surface. Pressed-steel draft sills are



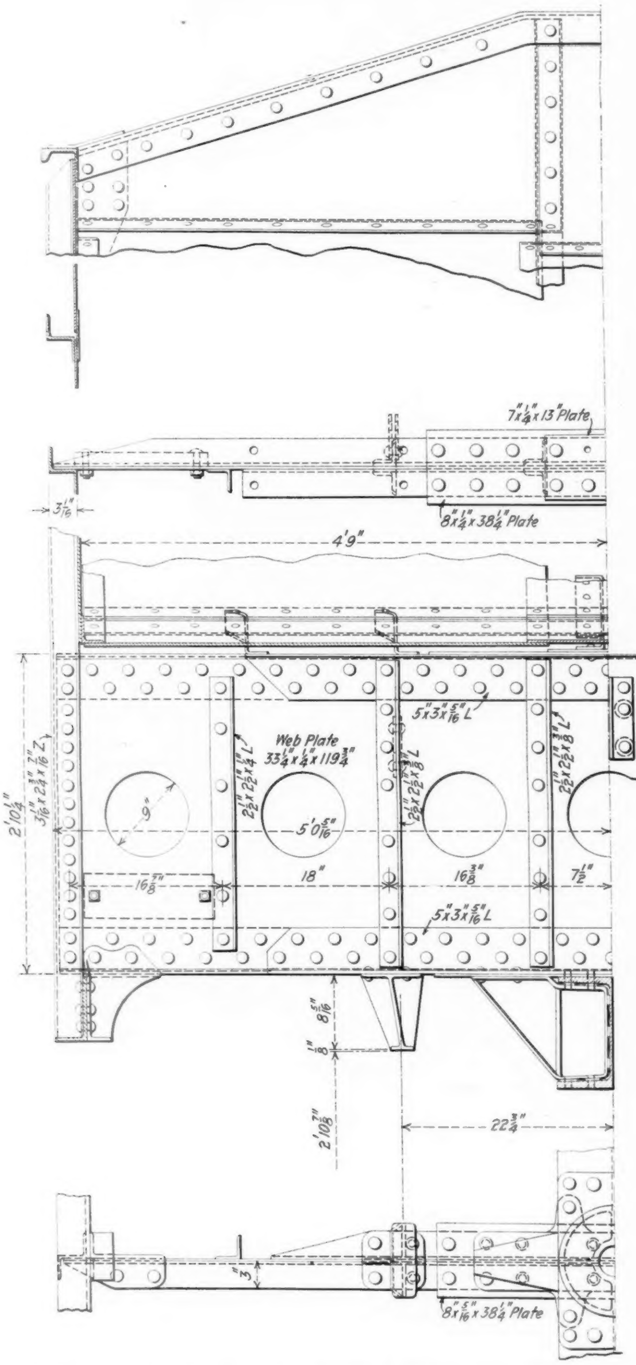
Arrangement of the Draft Sills and Draft Gear



Elevation, Plan and Cross Sections of the Norfolk & Western Hopper Car

spliced to the center sill by means of a steel back-stop casting and top and bottom cover plates. The draft gear stops against this casting in buffing and the back stop casting is arranged to directly abut the end metal of the H-section, so that all the buffing load is delivered to the center sill without depending on rivets for this purpose.

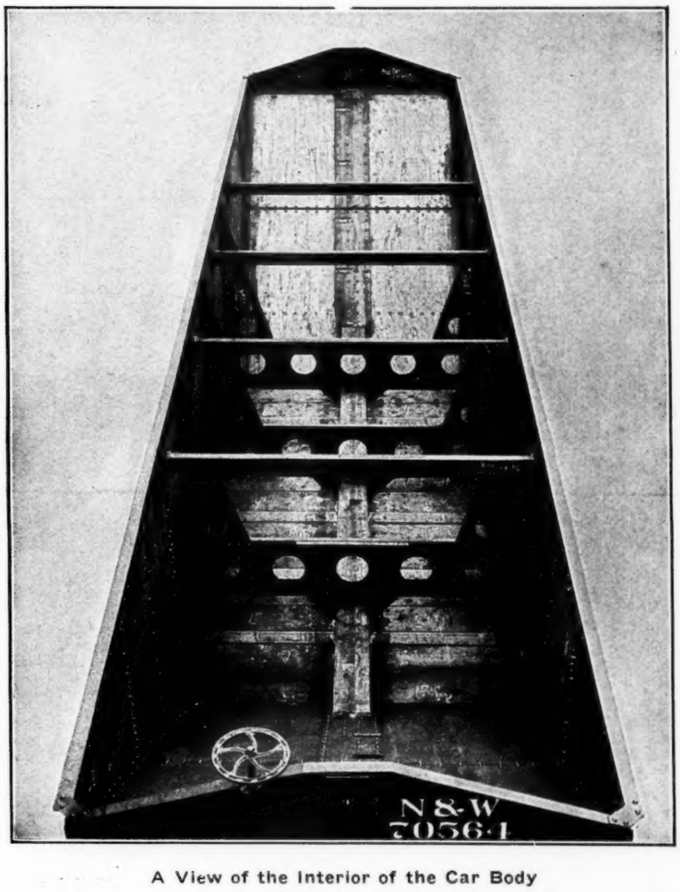
The draft sills are made of 7/16-in. steel plates, flanged, and are tapered from 12-in. in depth at the rear to 15-in. in depth at the front end and are spaced 15½ in. between the webs.



Details of the Bolster and Elevation of the Hopper End of the Norfolk & Western Hopper Car

The Farlow one-key draft attachments are used. The cheek plates are riveted to the inside faces of the draft sills and form the stops for the front follower in pulling. The yoke is laid horizontally and is continuous. The buffing load is transmitted through the rear end of the yoke directly to the back stop casting. A 1½-in. by 5-in. key is used for connecting the coupler to the yoke, and it will be seen from the draft gear layout that an exceptionally large bearing surface has been provided between the key and the yoke and between the key and the coupler. The key has been relieved of all bending stresses by allowing the outward extensions of the back key bearing on the coupler to overlap the inside extensions of the front yoke bearing.

The car is equipped with Sessions type "K" friction draft gear, and the coupler used is the M. C. B. 6-in. by 8-in., type "D," with a shank 21¼-in. long. For a carrier iron a 5-in. by 3½-in. by 7/16-in. angle is used. This is supported upon flanges cast from the cheek plates and is held in place by two bolts through the vertical flange of the angle. The weight of the coupler is carried directly on the cheek plate shelves, upon which rests the horizontal flange of the carrier, and the bolts merely keep it in place. The coupler limit stops are formed by turning up the horizontal leg of the angle iron at the ends. By this arrangement removing the carrier iron also removes the limit stops and the yoke can then be drawn out of the end of the coupler pocket.



A View of the Interior of the Car Body

The car is built up of plates and structural shapes, the minimum plate thickness being ¼ in. Three diaphragms or transverse plate girders are placed across the car to support the center sill and transfer the weight of the lading to the sides of the car. At these diaphragms are placed inside side stakes and wing plates are also carried up from the diaphragms to a point near the top coping angle to stiffen the sides of the car. Midway between the diaphragms are placed outside side stakes of Carnegie M-24 cross-tie section. The splices in the side sheets are made at these stakes. Cross-ties of 5-in. I-beam section are placed across the coal-space near the top of the car in the same transverse planes as the side stakes. The side stakes support the car against the cradle of the car dumper, over which the car must be handled at times.

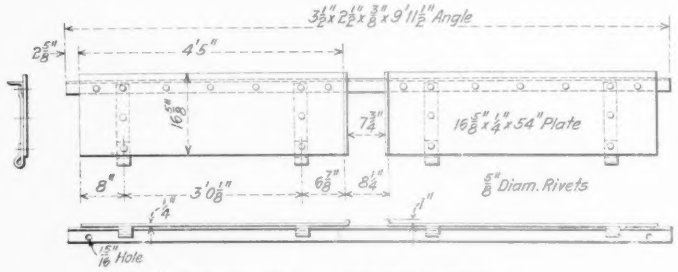
The top coping angle is a Carnegie bulb angle of 4-in. by

3½-in. by ⅜-in. section, which extends the full length of the car. For a bottom flange member a 5-in. by ⅝-in. flat bar is used; this member is in tension only. Where the load requires it, near the center of the car, this bar is reinforced with 5-in. by 5/16-in. flat bar.

The slope of the hopper is 33 deg. and between each pair of doors is a small hood to make the car entirely self-cleaning. These hoods are likewise constructed to have slope angles of 33 deg.

The ends of the car are formed into plate girders and are carried up to form end coal boards, thus encouraging filling out the ends of the car at the tipples and insuring a good heap. The outer ends of the draft sills are supported from these end plate girders by two 4-in. by 3-in. by ¼-in. vertical angles. Care has been taken to properly attach the end plates to the corners of the car so that the downward forces from the coupler may be properly transmitted to the sides of the car.

The end sill is an 8-in., 11¼-lb. channel, which is framed



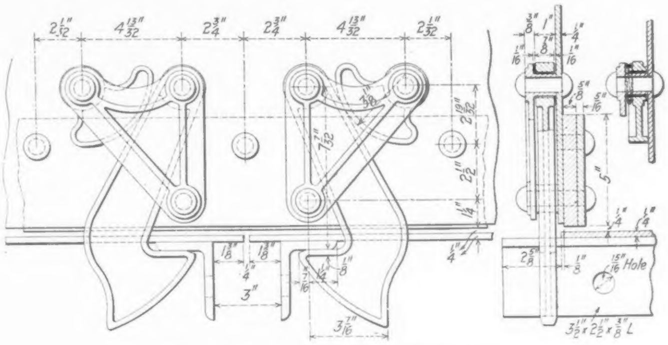
Construction of the Drop Doors

at the corners to 7-in. by 3½-in. by ⅜-in. angles forming short side sills under the slope of the hopper.

Diagonal braces of 7-in., 12-lb. channels are used, extending from the corners of the car to the back end of the draft sill corner plates, to which they are riveted.

each end of the bolster a 3 1/16-in. by 2¾-in. by 7/16-in. Z-bar is used. The web plate of the bolster is carried out and riveted directly to the web of this Z-bar, thus avoiding a duplication of rivets and framing angles at this point. Jacking pads are provided at the ends of each bolster so that the car may be jacked at one point and stooled at the other.

The doors are supported by a simple door hook arrangement manufactured by the Wine Railway Appliance Company. No winding shafts are used, the doors being raised by

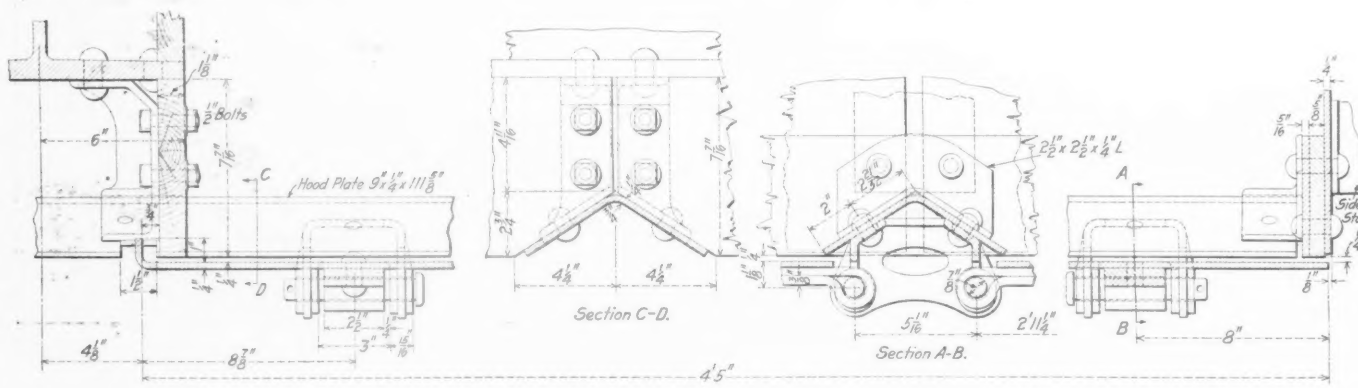


The Drop Door Latch and Lock

hand. This arrangement is shown in detail in one of the drawings.

The center sill where it passes through the coal space of the car is faced between the flanges with 1⅛-in. oak boards so as to present smooth sides for the coal when dumping from the bottom or in the dumping machine.

The car is equipped with the Lewis articulated six-wheel trucks as manufactured by the American Steel Foundries. It is fitted with Westinghouse 10-in. by 12-in. air brake equipment. The hand brake is of the customary pattern, except that the brake staff is made in two pieces with reduction gears placed between them in order to give the necessary



Cross Sections Showing the Details of the Doors for the Norfolk & Western 100-Ton Coal Car With Their Attachments to the Car

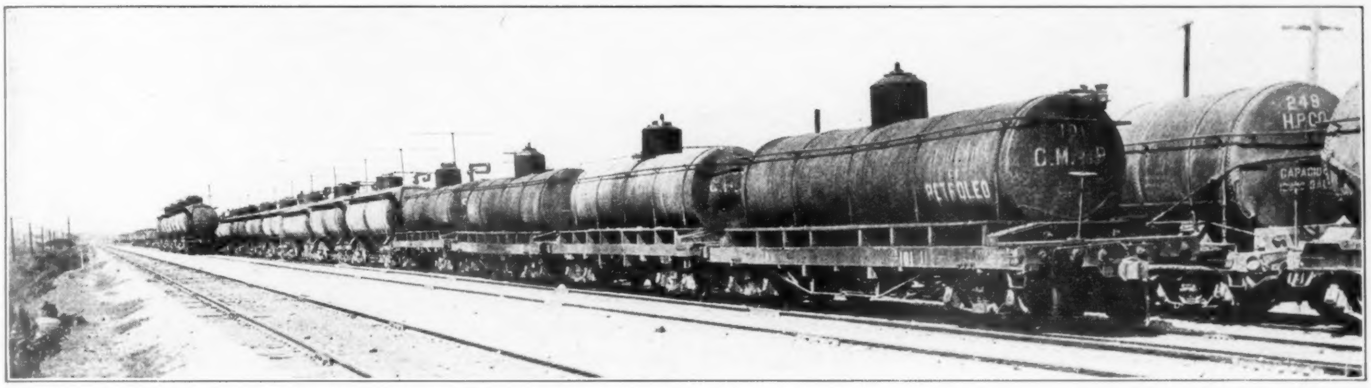
At each corner is a push-pole pocket which also includes a jacking pad beneath the corner construction. The design of the corner has been so worked out that, either in poling or jacking, the end metal of the structural sections come into bearing, and the load is transmitted to them without depending upon the rivets. Special provision has been made at the top of the 4-in. by 4-in. by 5/16-in. corner angles to take care of the loads at this point when the car is stooled under the corner jacking pads.

The bolsters consist of plate girders which are located above the center sill and beneath the hopper chute. These are constructed of ¼-in. web plates with top and bottom flange angles on both sides of the plate, and cover plates. The angles on the inside of the web plate and the cover plates are stopped off where the reduction in stress permits. For a side stake at

braking power without having an excessive amount of chain to wrap.

During the several months that this car has now been in service its performance has been entirely satisfactory. The general dimensions are as follows:

Inside length	45 ft. 6 in.
Coupled length	49 ft. 2 in.
Length over striking faces	46 ft. 7½ in.
Truck centers	34 ft. 2 in.
Inside width	9 ft. 6 in.
Extreme width	10 ft. 1¼ in.
Height to top of sides	11 ft.
Extreme height	12 ft. 10⅞ in.
Volume, level full	2,828 cu. ft.
Volume, 30-deg. heap	552 cu. ft.
Volume, total	3,380 cu. ft.
Capacity	100 tons
Light weight	60,000 lb.



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THE TANK CAR IN INTERCHANGE

Characteristics of the Different Types Under M. C. B. Specifications; Important Points for Car Inspectors

BY E. S. WAY

Superintendent of Equipment, General American Tank Car Corporation

IN 1916 the M. C. B. Tank Car Committee went into the question of the construction of tank cars more thoroughly than ever before and new specifications were adopted. In addition definite classifications were given as follows:

Class I.—Tank cars for general service, with wooden or steel underframes, or without underframes, built prior to 1903.

Class III—Tank Car Built According to MCB 1917 Specifications

Class II.—Tank cars for general service, with steel underframes or without underframes, built between 1903 and May 1, 1917.

Class III.—Tank cars for general service built after May 1, 1917.

Class IV.—Tank cars for the transportation of volatile inflammable products whose vapor pressure at a temperature of 100 deg. F. exceeds 10 lb. per sq. in., built after May 1, 1917.

In 1917 some minor changes were made in the specifications for Classes III and IV. Provision was also made limiting the use after January 1, 1918, of Classes I and II cars, where the tanks have been tested to only 40 lb. per sq. in., to the transportation of products whose vapor pressure at a temperature of 100 deg. F. does not exceed 10 lb. per sq. in., and which do not give off inflammable vapors at or below a temperature of 80 deg. F. In addition, detailed specifications were adopted under the following head:

Class V.—Insulated tank cars of especially heavy construction, built after January 1, 1918, for the transportation of liquid products whose properties are such as to involve danger of loss of life in the event of any leakage or rupture of the tank. Liquid products of this description whose shipment has been authorized are: chlorine and sulphur dioxide.

The third paragraph of the Preface of the M. C. B. Code of Interchange Rules reads:

"Inspection of freight cars for interchange and method of

*From a paper presented before the Car Foremen's Association of Chicago.

loading will be in accordance with this Code or Rules, the Specifications for Tank Cars, and the Loading Rules, issued by this Association."

Thus it will be seen that the tank car specifications practically become a part of the interchange rules, and it therefore devolves upon the car inspector to utilize his leisure moments in familiarizing himself with these requirements.

To assist those not already familiar with the requirements, to differentiate between the different classes of cars, the following points will probably be of assistance:

The tank car specifications define a tank car as follows:

"Any car to which one or more metal tanks, used for the transportation of liquids or compressed gases, are permanently attached.

"Note—These specifications do not apply to cars having wooden or glass lined tanks; nor to tanks enclosed in box or other house cars.

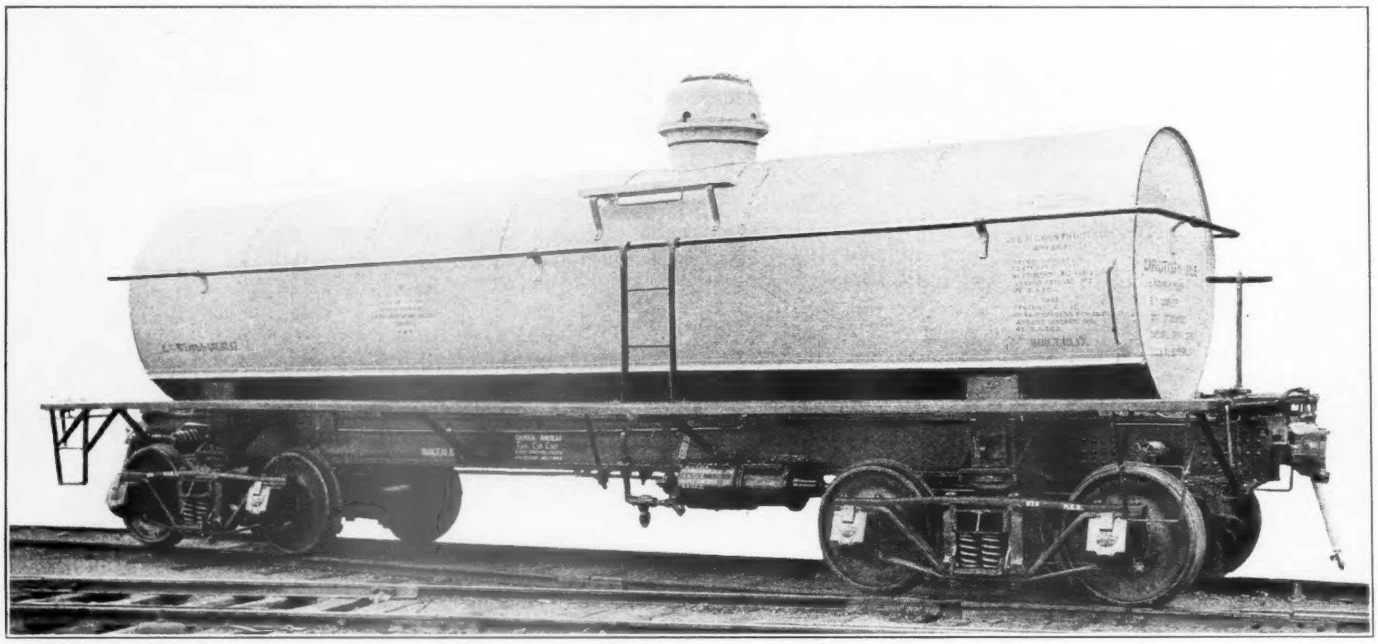
"Sec. 23, Test of tanks, does not apply to cars specially designed for the transportation of solids, such as lime nitrogen.

"To indicate to inspectors and others handling cars with wooden or glass lined tanks or cars specially designed for the transportation of solids that such cars do not come under words, it must be secured to the underframe by some means other than by the use of head blocks.

(c) Safety appliances must conform to the arrangements shown in Fig. No. 7 of the specifications for tank cars revised 1917, the principal points of which are that the running boards must have a maximum height not to exceed 50 in. above the top of the rail, and the tank must be provided with dome ladder, dome platform and hand holds.

The Class IV car is constructed practically the same as the Class III car, the idea being to make it possible to convert the Class III into a Class IV car if desired. The principal difference between the two is that the Class IV car must be insulated by the use of insulating materials and, in addition, the entire tank covered by a metal jacket. Further, these tanks must be tested with cold water at a pressure of not less than 75 lb. per sq. in. and so stenciled, although in some instances they may be found to be stenciled as tested at 100 lb., which was required prior to May 1, 1917.

The Class V car is insulated and in general appearance resembles the Class IV car. It can be distinguished, however, from the latter by the test stenciling, which will show a pressure of 300 lb. per sq. in. Further, the safety valve and other dome fixtures, which are especially designed, are en-



Class V—Insulated Tank Car for the Transportation of Liquified Chlorine

the provisions on the tank car specifications, the words 'Wooden-lined Tank—Pressure Test not Required,' or 'For Solids Only—Pressure Test not Required,' as the case may be, should be stenciled on the tank in place of the record of test of tank."

Generally speaking, the "Date Built" as stenciled on both the tank and underframe will serve as a guide to inspectors.

The majority of wooden underframe cars will be found to be Class I cars and built prior to 1903, although there were some steel underframe tank cars built prior to this date which would be subject to Class I requirements.

All tanks having single riveted seams and mounted on steel underframes or without underframes, built subsequent to 1903, will be subject to Class II specifications. However, there were tanks built with double-riveted seams prior to May 1, 1917, which would likewise be Class II cars.

The outstanding features of Class III tank cars are:

(a) The tanks are double riveted throughout with the exception of the dome head seam, which may be single riveted.

(b) Tank secured to underframe by anchorage at the bolsters or at some point or points between bolsters. In other

tirely covered by a metal casing, the object of this being to prevent damage to the valves and consequent escape of the contents in case of wreck or accident. This latter feature is very important by reason of the deadly fumes given off by either chlorine or sulphur dioxide.

Care will of course have to be exercised to distinguish the Class IV and Class V cars, both of which are insulated, from other insulated cars that are used for the transportation of water, wine, hot pitch, etc., the test pressure of which will not exceed 60 lb. per sq. in.

The specifications as revised in 1916 and 1917 also refer to the tank car that is rebuilt either by the application of a new tank or a new underframe. Such cars, if rebuilt after May 1, 1917, must have the tanks secured to the underframe by some means other than headblocks and must have the safety appliances standardized to meet the requirements for new cars. There are of course additional requirements, but the two just referred to are perhaps the most prominent.

Let us now consider briefly the various interchange rules relating specifically to tank cars:

Rule 2, Section B, second paragraph—"Cars containing

inflammable liquid which is leaking must be repaired or transferred without any unnecessary movement or at nearest available point."

The proper application of this provision necessitates inspectors being familiar with the facilities, at or nearest to their respective districts, for either repairing such car or for the transfer of lading, as the case may require.

Rule 3, Section E—"Tank cars (empty or loaded) will not be accepted in interchange unless they comply with the M. C. B. Tank Car Specifications."

This is a rule which, like some other rules in the interchange code, if applied literally and without the exercise of good judgment, will work hardships on the delivering line as well as on the shipper. A thorough knowledge of the specifications is therefore necessary in order that the purpose of this rule may be intelligently served. To be more explicit, there may be certain conditions found on a tank car that do not fully comply with the detailed requirements, but which would not interfere with the safe movement of the car or contents. The rejection of a tank car because of such conditions would in most cases serve no good purpose, but on the contrary may, from a carrier's viewpoint, result in unnecessary and undesirable movements, as well as delays that would be serious and expensive to the car owner or shipper. Obviously, the proper procedure in such cases would be to report the objectionable features to the car owner who could have them corrected at the first opportunity.

Rule 3, Section (g)—regarding stenciling date built on cars provides that in the case of tank cars the body and tank should bear distinctive dates unless constructed at the same time. This rule became necessary on account of the large numbers of wooden underframe tank cars being rebuilt with steel underframes, the stenciling of the date built on both tank and underframe serving as a basis for depreciating the value of tank and underframe separately in cases of destroyed cars and also serving as a guide to inspectors in checking up rebuilt tank cars with the specifications for the reason that tank cars rebuilt after May 1, 1917, are subject to 1917 revised specifications.

On pages 17, 19 and 21 of the interchange code will be found a number of interpretations relating to tank cars. These interpretations are self-explanatory. There is one point, however, which it might be well to mention, viz., the requirements relating to test of tanks and safety valves. There appears to be some misunderstanding on the part of the railroads as to their responsibility in the matter of testing tanks and safety valves where the test periods expire while cars are in their possession. In a number of such instances, certain railroads have taken the question up with the car owners asking disposition of the cars whereas they should make the necessary tests at the nearest point where they have facilities for handling this work, which they are obliged to do under the M. C. B. rules. In other words, these tests should be treated the same as any ordinary repairs to freight cars.

Rule No. 9, last paragraph, states: "When tank or safety valve of tank cars is tested in accordance with the M. C. B Specifications for Tank Cars, the certificate of test, as required by the Interstate Commerce Commission Regulations, must accompany the billing repair card."

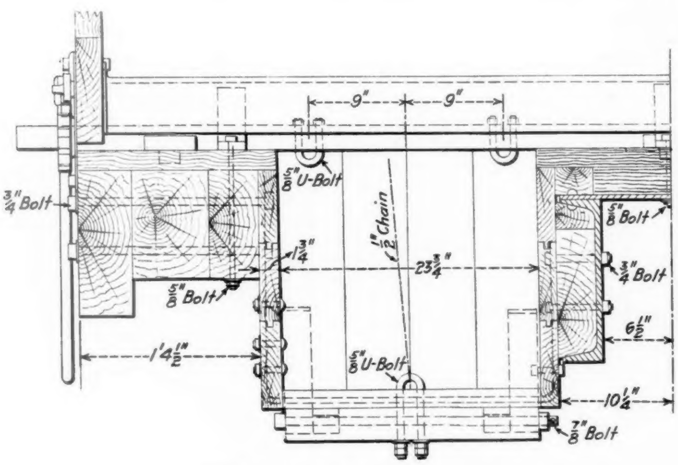
The certificate of test is a form prescribed by the Bureau of Explosives, and it is very important that it be properly executed as required. When tests are made by parties other than the owners, the certificate of test should be made out in triplicate, one copy to be retained and two sent to car owner.

There are a number of rules contained in the Bureau of Explosives Pamphlet No. 9 which should be carefully studied in connection with this subject.

C. M. & St. P. Fifty-ton Gondolas

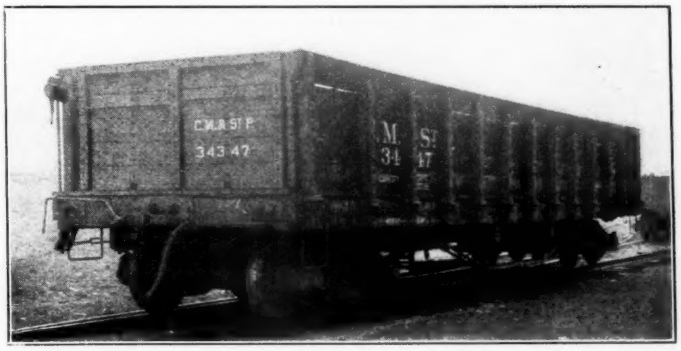
Steel Center Sill Designed to Resist Buffing Stresses Only; The Load Is Supported by Six 1½ in. Truss Rods

The Chicago, Milwaukee & St. Paul is now building at its shops at Milwaukee and Tacoma 1,500 50-ton gondola cars. A composite design has been adopted for this equipment, principally on account of the difficulty of securing prompt deliveries of steel at this time. Although heavy sills are used, the ratio of light weight to capacity has been kept reasonably low, the average light weight being 42,100 lb. It will be seen, therefore, that the ratio of the revenue load to the maximum total weight of these cars is 72.3 per cent.



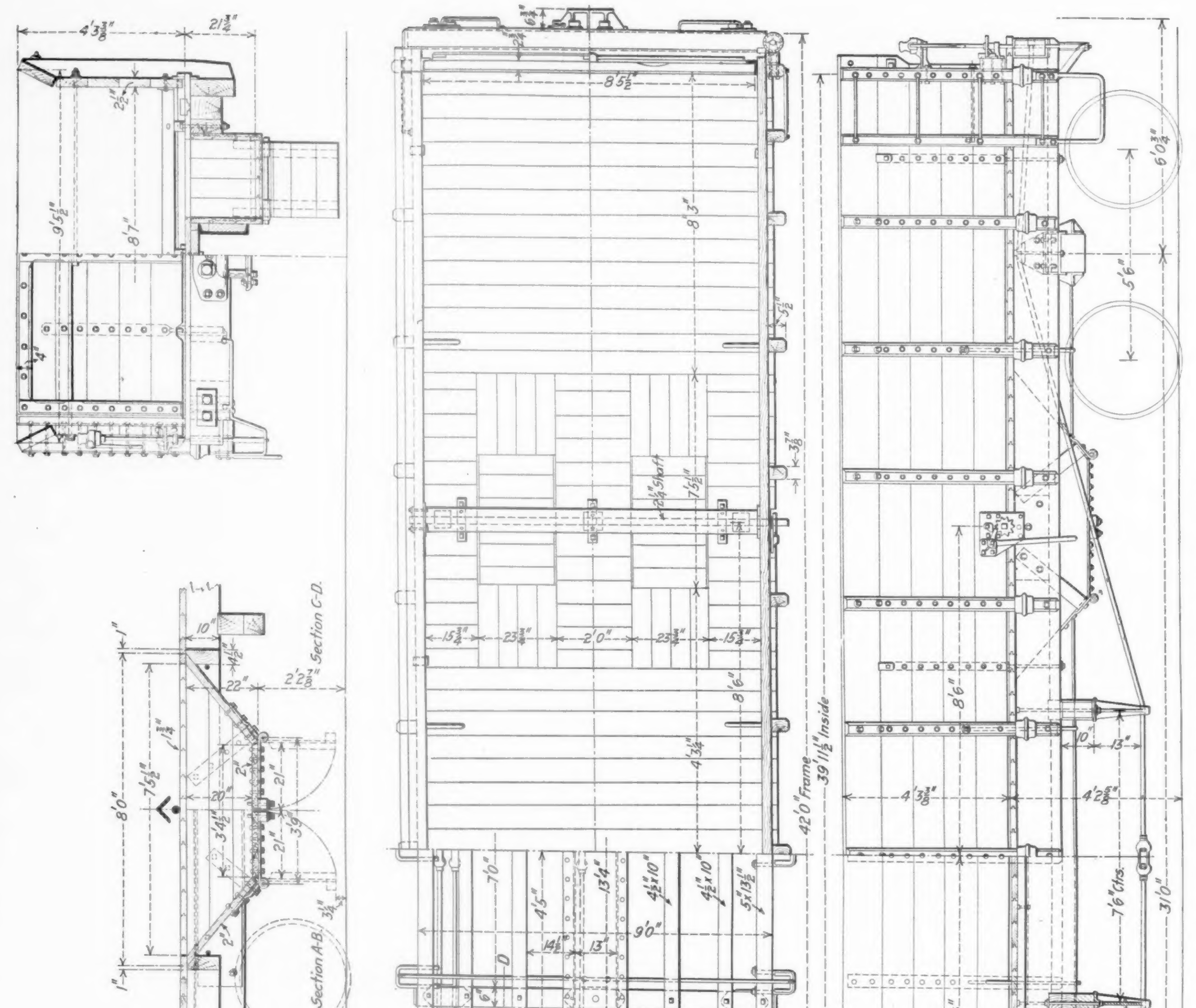
Cross Section of Car at Hopper

In the design of the car the principal aim was to use wood as extensively as possible and yet provide a car that would give good service and insure economy from the standpoint of maintenance. With this thought in view, a heavy steel center sill has been provided to take care of the buffing and pulling stresses, while the weight of the body and lading is carried on wooden sills and truss rods. The length of the car over the end sills is 42 ft., the maximum width, 10 ft. 1½ in., and the maximum height from the top of the rail, 8 ft. 6¼ in. The body of the car is 39 ft. 11½ in. long, 8 ft. 7 in. wide, and 4 ft. 3⅜ in. deep. The cubical capacity of the car, with the load heaped 2 ft. above the sides, is 2,000 cu. ft.



Hopper Car for the C. M. & St. P.

In the construction of the car body the metal parts have



General Arrangement of the C. M. & St. P. 42-Ft., 100,000-Lb. Capacity Gondola Car

been confined almost wholly to the center sill members. Two channels, of 15-in. 37-lb. section, extend from end to end of the car and are reinforced for the entire length by 1¼-in. by 20-in. cover plate. Under the center sills two truss rods, 1½ in. in diameter with 1¾ in. upset ends are provided to carry the weight of the lading. The body bolsters are built up of rolled sections and filler castings. The tension member, which passes through the neutral axis of the center sills, is ¾ in. by 12 in., while the compression member is 1⅛ in. by 12 in.

The sides of the car body are supported by two wooden sills, the outer 5 in. by 13½ in., and the inner 4½ in. by 10 in. These sills are also reinforced with two 1½-in. truss rods.

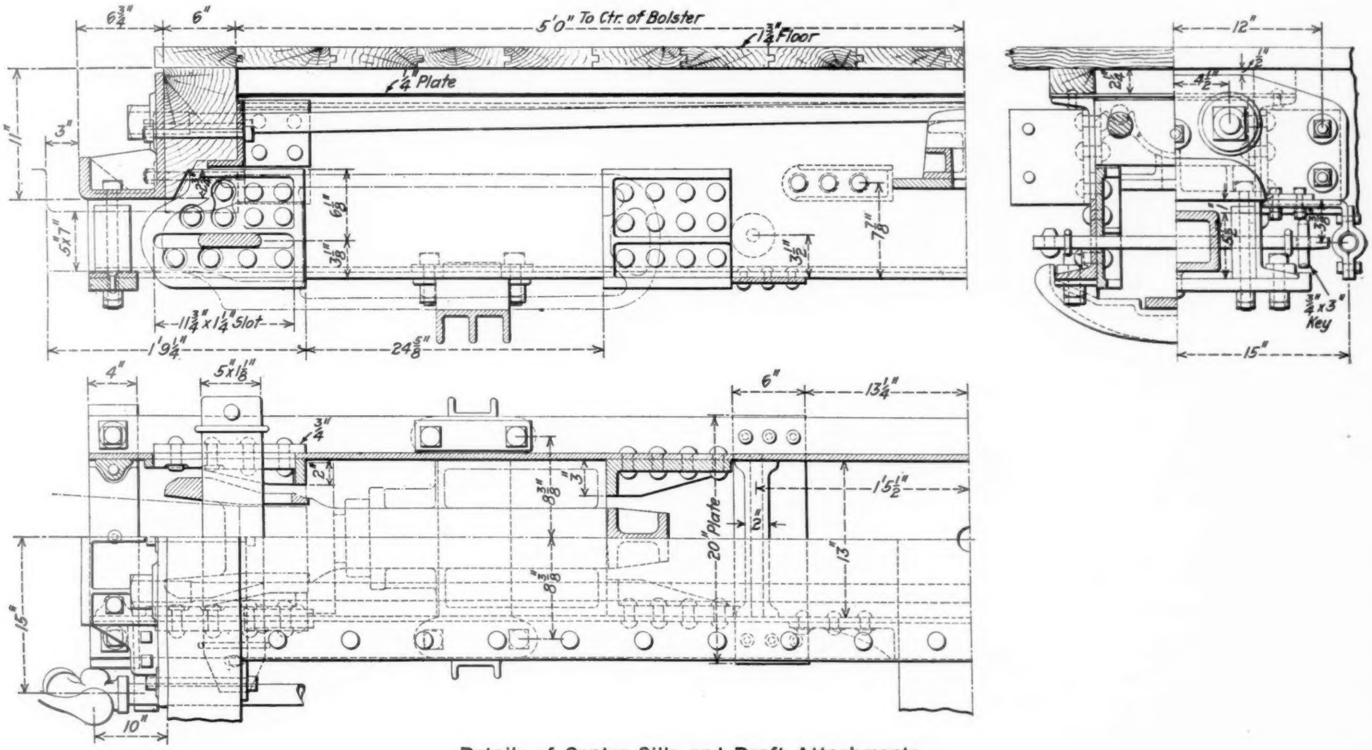
The four hoppers, 23¾ in. wide and 8 ft. long are placed between the center sills and side sills, the centers being 12 ft. 3 in. from the ends of the car. Short intermediate sills extend from the ends of the car to the hoppers and between the hoppers, being supported by the end sills, body bolsters and needle beams. The side stakes are 3⅞ in. by 5½ in. Every third pair of stakes is tied together with a ¾ in. rod extending under the center sill. The sides of the car body are 2½ in. thick and the floor is 1½ in. thick.

The hoppers are reinforced on the sides and the ends by metal strips bolted on the inner side to the center sill channel and on the outer side to the two side sills. The dumping mechanism consists of 2¼-in. shafts extending across the car above the deck, with chains to raise the hopper doors. A 5-in. by 5-in. angle iron is placed over each shaft to protect it from the lading.

The details of construction of the hoppers are shown in one of the illustrations.

On account of the difficulty of securing clearance between the brake wheel and the end of the car, special types of ratchet brakes have been applied.

Among the specialties used on these cars are Bettendorf truck side frames, Bettendorf and Buckeye cast steel truck bolsters, Barber lateral rollers, Ajax brake beams, Major couplers with Buckeye cast steel yokes and the Miner friction draft gears.



Details of Center Sills and Draft Attachments

HELICAL SPRING CALCULATION

BY ALBERT H. LAKE, JR.

Where the end for a helical compression spring as shown in Fig. 1 is not formed by grinding, but is forged and drawn out, the bar that the spring is made from is some shorter than the bar in the finished spring.

Fig. 2 shows an improper form of end for a compression spring. The end of the tapered part should not come in contact with the adjacent coil as that would make this coil non-effective from the point of contact to where the taper starts, which would be one-quarter of a coil.

Fig. 3 shows a correctly tapered end before coiling.

In the following formulas:

d = diameter of bar from which spring is made
D = mean diameter of coil
h = solid height of spring
L = blunt length or length that bar is cut from stock
L_1 = length of tapered part on each end of bar
L_2 = total length after tapering
N_1 = number of effective coils
N_2 = total number of coils

The length of the tapered part on each end should be three-fourths of one coil or $L_1 = \frac{3 \times D \times 3.1416}{4}$

The thickness *A*, Figs. 1 and 3, at the end of the tapered part should be equal to one-fourth of the diameter of the bar or $\frac{d}{4}$, as this will bring all of the coils in contact at the same time when the spring is compressed solid.

The familiar formula $N = \frac{h}{d}$ where N = the number of coils, can only be used to find *L*, as it gives neither the total number or effective number of coils.

The length of bar required, that is, the blunt length to be ordered or cut from stock, is found by the formula

$$L = \frac{3.1416 \times D \times h}{d}$$

This is true only when the tapered part is made as shown

in Fig. 3 where L = blunt length, L_1 length of tapered part, X = one-half of one coil, y = one-fourth of one coil, and

$$A = \frac{d}{4}$$

The number of effective coils is found by the formula

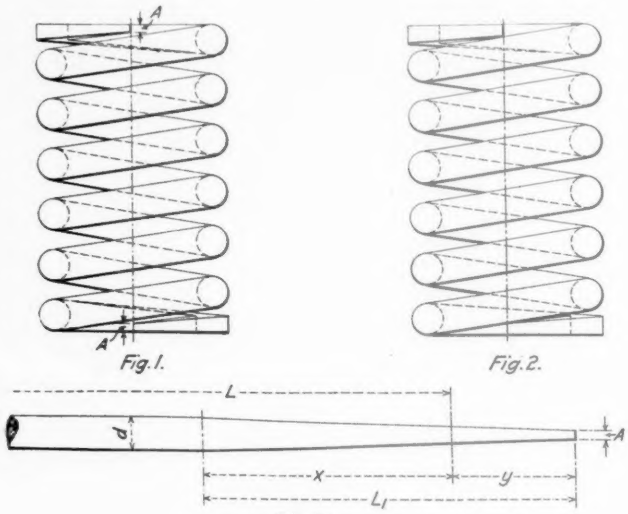


Fig. 1. Fig. 2.

Fig. 3.

Taper End Helical Springs

$$N_1 = \frac{h}{d} - 1$$ and the total number of coils by the formula

$$N_2 = \frac{h}{d} + 0.5$$

of the following dimensions: d = 1 in., D = 5 in., h = 6.5 in., then:

$$L = \frac{3.1416 \times 5 \text{ in.} \times 6.5 \text{ in.}}{1 \text{ in.}} = 102.1 \text{ in.}$$

$$L_1 = \frac{3 \times 5 \times 3.1416}{4} = \frac{47.124}{4} = 11.78 \text{ in.}$$

$$L_2 = \frac{3.1416 \times 5 \times 6.5}{1} + \frac{3.1416 \times 5}{2} =$$

$$102.1 + \frac{15.708}{2} = 109.95 \text{ in.}$$

$$N_1 = \frac{6.5}{1} - 1 = 5.5$$

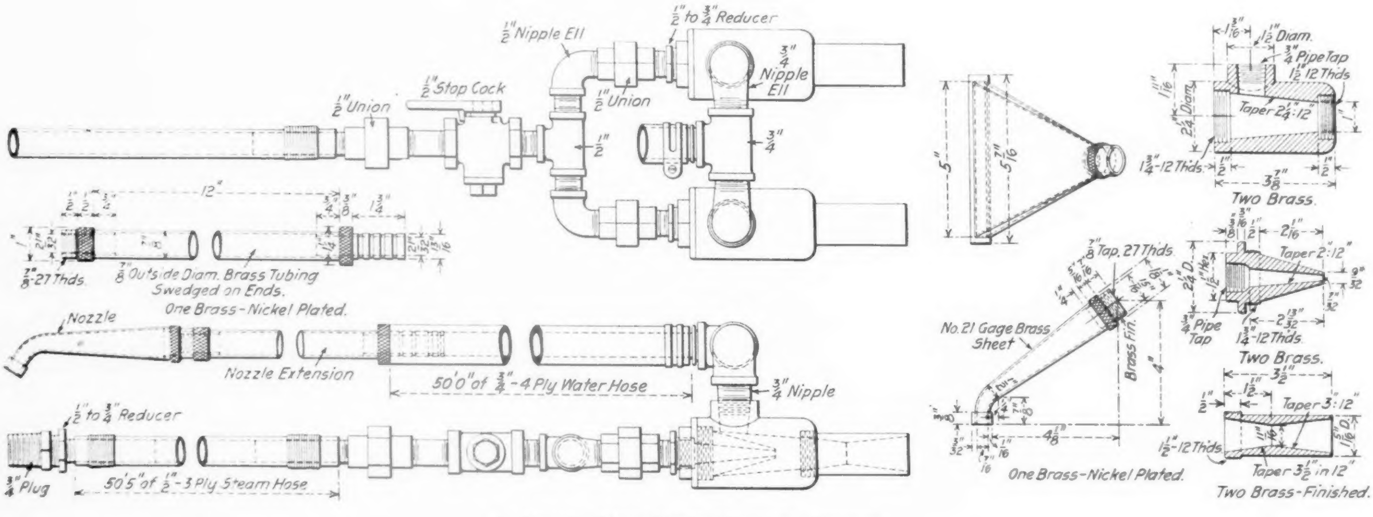
$$N_2 = \frac{6.5}{1} + 0.5 = 7$$

VACUUM CLEANER

BY HOWARD W. STULL
Machine Shop Foreman, Philadelphia, & Reading, Reading, Pa.

A vacuum cleaner is shown in the drawing which was developed on the Philadelphia & Reading. It has been in successful use on that road for about a year in cleaning passenger cars and offices at points where compressed air is available. The device is intended to be left on the platforms of cars and in the hall outside of office doors while in operation, a 50-ft. length of four-ply water hose being used to make this possible.

One of the difficulties which is experienced with many



A Simple Shop-Made Vacuum Cleaner

On drawings of helical springs the length of bar is generally given thus:

One Bar 1 3/16 in. diameter, 73¾ in. long, tapered to 80⅜ in.

The 73¾ in. would be found by the formula:

$$L = \frac{3.1416 \times D \times h}{d}$$

And the 80⅜ in. by the formula:

$$L_2 = \frac{3.1416 \times D \times h}{d} + \frac{3.1416 \times D}{2}$$

To illustrate the use of the above formulas assume a spring

vacuum cleaners is that they become stopped up, especially in very damp weather, and are not easily cleaned out. It will be noticed that with this cleaner the vacuum chambers may be cleaned out very readily by removing the combining nozzles and turning on the compressed air. The vacuum gage registers about 18 in. when using the cleaner with air pressure at 100 lb. per square inch. Of course, a higher vacuum may be produced if higher air pressure is available.

Little need be said relative to the construction of the device, as the drawing clearly shows all the details. As developed on the Philadelphia & Reading, the parts are made of Brass, but there is no logical reason why cast iron can not be used if desired.

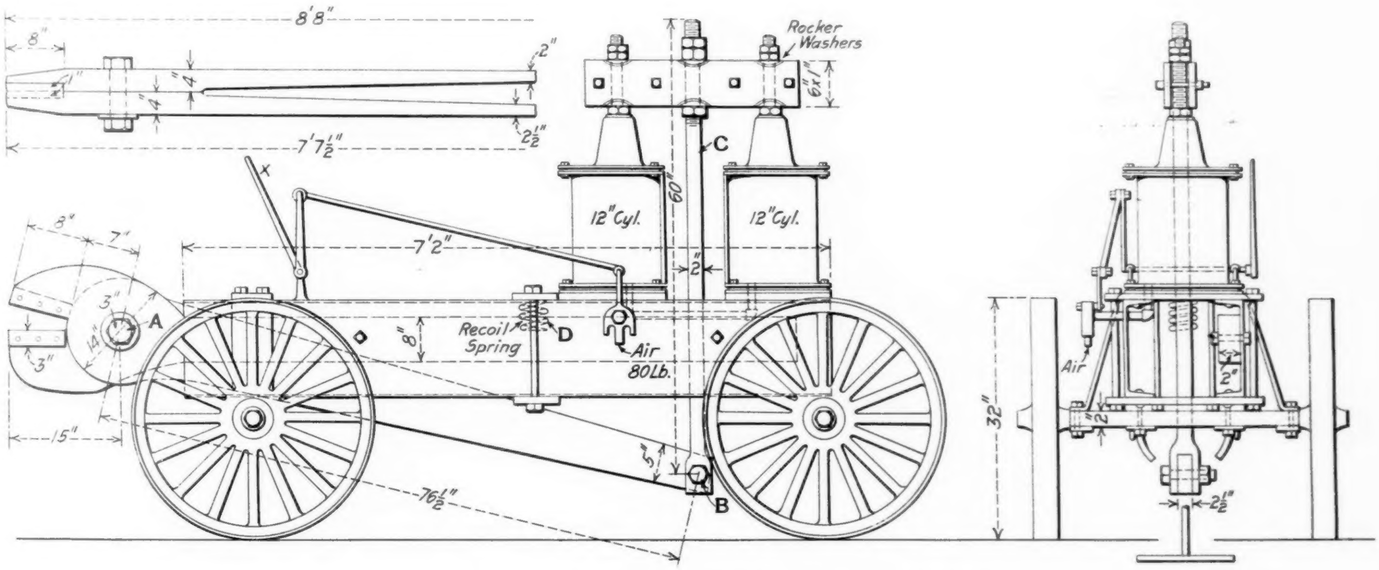
PORTABLE ALLIGATOR SHEARS

BY E. S. NORTON

The portable alligator shears illustrated were made at Conneaut, Ohio, by the New York, Chicago & St. Louis for cutting up scrap iron rods, and they have proved a valuable asset to the reclamation and scrap handling department. Power is readily obtained from the shop air line and as the shears are portable they may be placed wherever is most convenient, thus reducing to a minimum the cost of handling tangled masses of scrap iron rods and bars. Eighty pounds air pressure will give sufficient shearing power to cut 1½-in. round iron or iron bars up to 1-in. by 3-in.

The machine is constructed entirely of second hand material and consists, as indicated, of two 12-in. brake cylinders bolted to a framework of 13-in. channel iron which is mounted on a portable truck. The shears are of the general dimensions shown, the lower shear being stationary and bolted firmly to the inside of the channel its entire length. The movable shear is supported by a 3-in. fulcrum pin at *A*, and from *B* is connected to the brake cylinders by a 2-in. rod and cross equalizer. It will be noted that ball joint washers are used in the construction and there is enough lateral play to prevent the rod bending should one piston start ahead of the other.

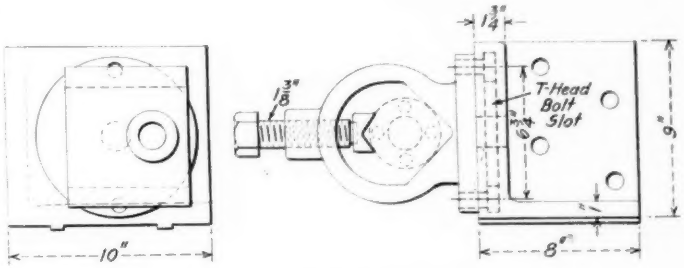
When the brake cylinder pistons are forced up by the air pressure, the motion is transmitted through connecting levers and operates the shear blades. The supply of air to the brake cylinders is controlled by a three-way valve, which in turn is operated by a handle *X* near the shears. In this way one man can hold on light work with one hand and operate the shears at the same time with the other. The recoil spring *D* is to take up vibration and shock due to the upward plunge of the pistons after the bar has been cut through. This machine has been in successful operation for some time.



Portable Alligator Shears for Cutting Scrap

A HANDY SWIVEL "V" BLOCK

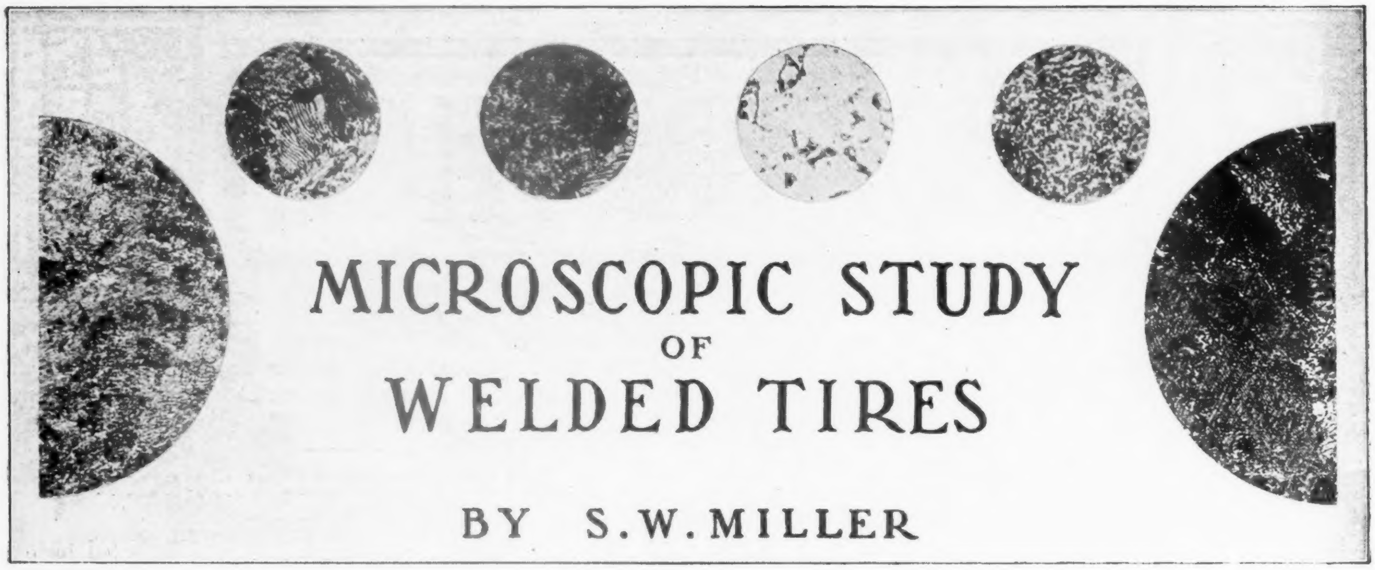
In making milling cutters or reamers with inserted teeth, considerable difficulty is often experienced in holding the work while performing operations on shapers or drill presses.



V-Block for Special Drill Press or Shaper Work.

To facilitate work of this sort the West Burlington shops of the Chicago, Burlington & Quincy have made a special chuck which has also been found handy for doing many other jobs.

The chuck consists of a V-block large enough to take pieces not more than 5 in. in diameter, with a screw for holding the work. The base of the V-block fits on an angle plate which is held in place by two T-head bolts in a circular slot. When in use the angle plate is bolted to the table of the machine on which the chuck is to be used.



MICROSCOPIC STUDY OF WELDED TIRES

BY S. W. MILLER

SOME time ago, the writer's attention was drawn to the fact that it was rather common practice to fill up slid flat spots on steel tires, and to make other repairs of a similar nature, by fusion welding methods, with a view to saving the metal of the tire which would have to be turned off to remove the flat spot. This practice was started because of the apparent resultant saving, not only in tire metal, but in repair cost and time, and if the method was successful it is obvious that this saving would be very great. But there

Fg. 1—Section of Tire Showing Welded Flat Spot.

was the possibility, and a very strong one, that such a method was in reality unsatisfactory, and even dangerous, because of the changes produced in the structure of the metal by the heat, which would change its physical properties.

As the writer knew of no tests showing what had occurred during and after the welding, he decided to make some for his own information, and the results so strongly confirmed his beliefs that they are here presented in the hope that those who may take the trouble to study the matter will see the danger of the practice. Fusion welding processes are capable of wide application, but they are not a panacea and should be used with discretion.

For the purpose of test a scrap tire from a switch engine, shown in Figs. 1 and 2, was selected and the physical and chemical properties were obtained from the manufacturers. A comparison of these properties with the A. S. T. M. specifications for standard switch engine tires is made in the accompanying table and shows that the tire selected for test met all the requirements.

The weld was made by the oxy-acetylene process, about ¼ in. of metal being added at the thickest part of the weld, and low carbon steel wire of about .08 per cent carbon content was used as a filler. After allowing the tire to cool to the room temperature it was marked off in sections beginning at the center of the weld, and extending beyond its end, as shown in Figs. 2 and 3. The sections were then cut off in a power hacksaw, polished, etched and photographed.

The etching showed that it was advisable to use three test pieces per section, and these were marked off, as shown on

	Tire to be tested	A. S. T. M. specifications
Tensile strength......	141,200 lb.	125,000 lb.
Elongation in 2 in....	11.1 per cent	8.0 per cent
Reduction of area.....	29.1 per cent	12.0 per cent
Carbon content........	.765 per cent	.70-.85 per cent
Manganese	.707 per cent	Not over .75 per cent
Phosphorus	.047 per cent	Not over .05 per cent
Sulphur............	.037 per cent	Not over .05 per cent
Silicon	.239 per cent	.15-.35 per cent

the lines on Fig. 4, which also shows the location, marking and hardness numbers obtained from Brinell and scleroscope tests.

These test pieces were marked to include, as far as could

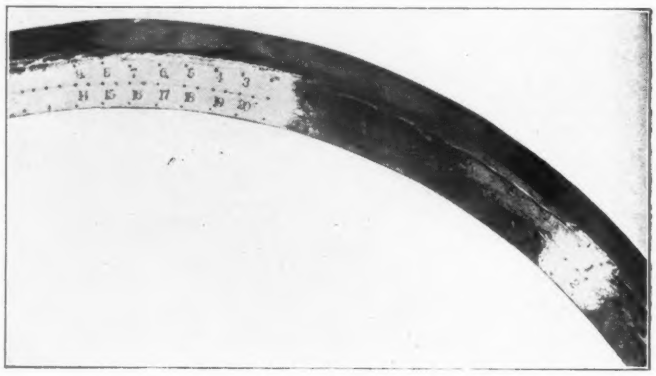


Fig. 2—Tire Marked off in Sections.

be seen, the same structure as shown by the coloration produced by the etching in Fig. 5, it being desired to obtain a number of test pieces from each type of zone. For example, it was thought that test pieces 4, 7, 10, 13 and 15 (Fig. 3) would probably give nearly the same results, but quite different from test pieces 6, 9, 12 and 14, which were in an entirely different zone, as shown by the etching.

The numbers in Fig. 2 were the ones for the original test pieces, and may be partly seen in Fig. 3, stamped into the sections. The white numbers in Fig. 4 are the ones later decided on, and which are used throughout this article.

It appears from Fig. 5 that the changes of structure indi-

cated may be divided into four principal zones. These are zone *A*, the added material; zone *B*, the darkest one which has the finest grain, having been heated above the critical range and rapidly cooled by conduction of the heat to the rest of the tire; zone *C*, the lightest one which has been heated within the critical range, and, therefore, softened, and zone *D*, intermediate in color, which has been heated below the critical range and, therefore, is not changed from the original with regard to grain size. This last represents, as nearly as possible, the original condition of the metal before the welding was done. There are also narrow transition zones between *A* and *B*, *B* and *C*, and *C* and *D*, which will be considered later.

Fig. 3.—Sections Cut From the Tire for Test.

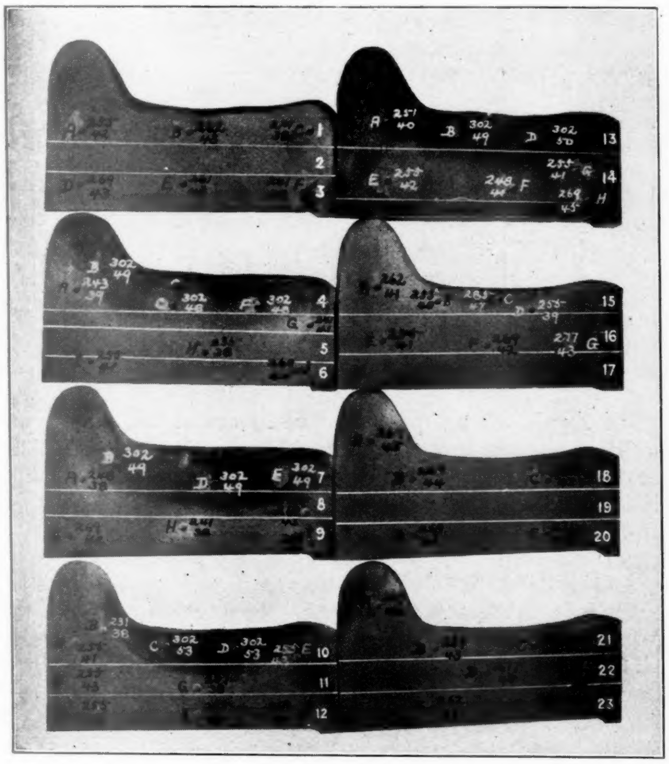


Fig. 4—Sections Polished and Etched Showing the Hardness Numbers

It is important to remember that, while the zones appear to be rather sharply defined, the temperature was not uniform in any one zone and gradations within each zone may be observed, except in zone *D*, which has been subjected only to a strong drawing heat, such as occurs some distance back of the point when a cold chisel is tempered after hardening. This heat has altered the physical properties, although it was not high enough to affect the grain size.

The light section of zone *C*, at the left of Fig. 5, is caused by the material in that vicinity having been heated twice. The added material was here first applied lengthwise near the flange, and later the welder returned along the outside of the tire, resulting in the second heating. Such an appearance is always noticeable when the material is so added.

The microscope is necessary to show the changes in the transition zones and the most important of these is the one between *A* and *B*. Here the steel has been decarbonized by the heat, and contains probably about an average of .4 per cent carbon. The width of this zone is from .05 in. to .08 in., and will vary with the temperature and its duration.

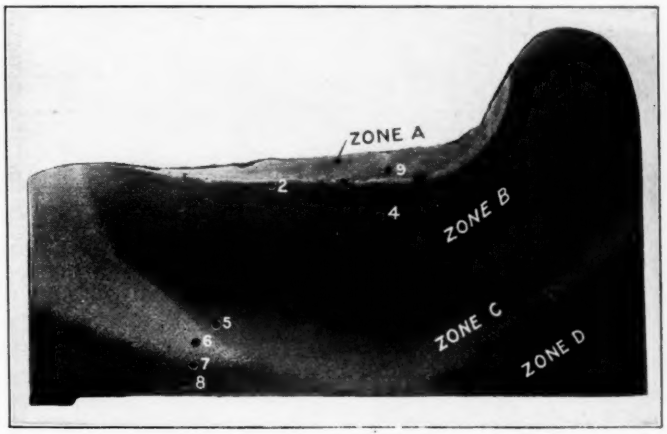


Fig. 5—Etched Section Showing Different Zones and Location of Photomicrographs

The zones between *B* and *C*, and *C* and *D* are wider, although it is hard to give the dimensions. And while there are considerable differences in the structure of the pearlite in any one zone, and while the difference between what might

be called a maximum condition in one zone and a minimum condition in another zone may be small, yet the *average* condition in one zone is very different from that in the other

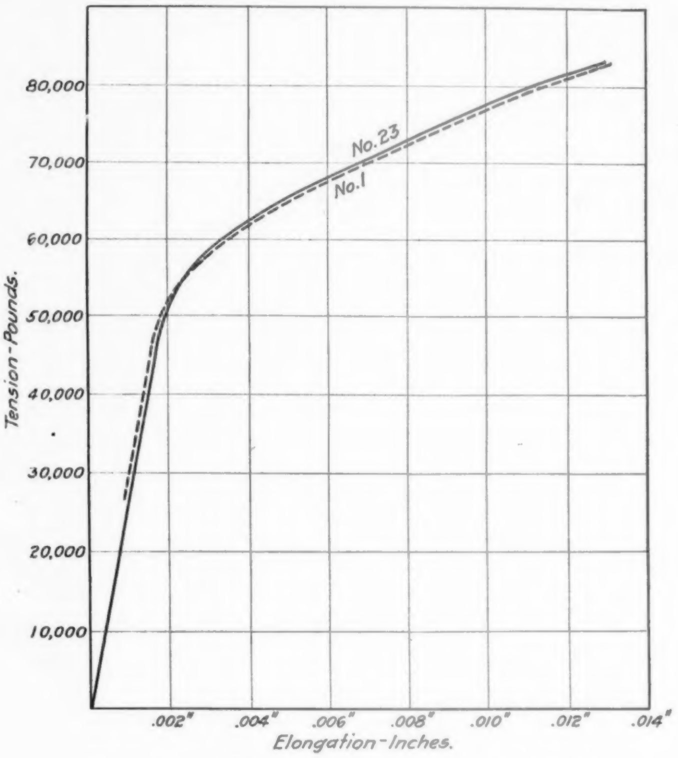


Fig. 6—Stress-Strain Curves For Original Material.

zone. A moderate magnification is best for locating such differences.

Tensile test pieces were cut from each section, so as to in-

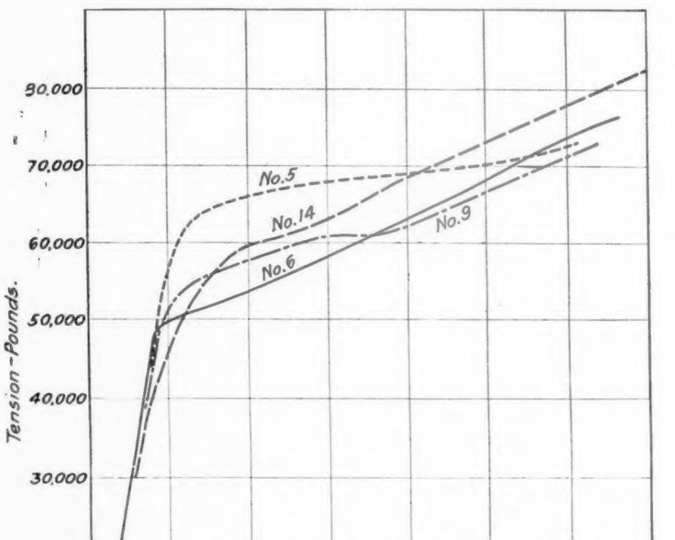


Fig. 7—Stress-Strain Curves For Zones C and D.

clude the different structures as nearly as possible and these were taken as shown by the white figures in Fig. 4. It was necessary to take them across the tire, and while objection may be raised to their not being taken parallel with the rolling, yet as the object was to see if any difference existed between the physical properties of the different structures, and as they are all taken in the same direction, it is believed that the results are comparative. A Berry strain gage was used to obtain the elongation.

It should be remembered that it was impossible to get the test pieces exactly from the places desired, and as the structure throughout any zone is not absolutely uniform, it could not be expected that the results of the physical tests would be exactly, or even very closely, the same for what appear to be the same zones. But, from appearance, test pieces 1 and 23 would be in the same zone—both of unaltered material; 4, 7, 13 and 15 would belong together, and so would 6, 9 and 14. No. 5 would seem to be in a class by itself. (These are the only test pieces from which accurate results were obtained.) It is rather noticeable that the stress-strain diagrams confirm these conclusions, as shown in Figs. 6, 7 and 8.

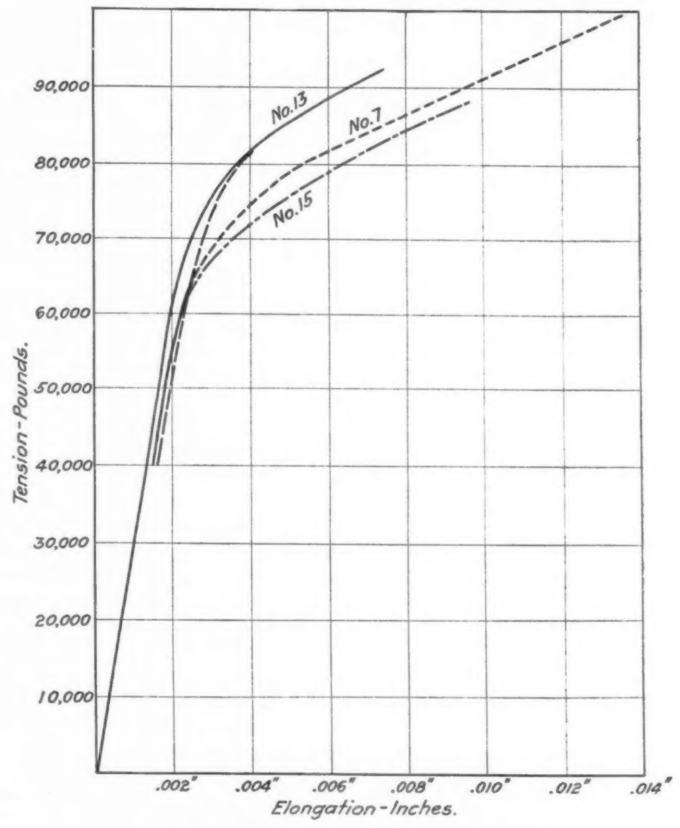


Fig. 8.—Stress-Strain Curves For Zone B.

The curves for test pieces 1 and 23 are of the same type, and lie remarkably close together. Those for 4, 7, 13 and 15 are of a much different type, the elastic limit being noticeably higher, and the material being much more brittle. Those for 6, 9 and 14 show a still different type, of a characteristic general shape, with a much lower tensile strength, but with the elastic limit nearly the same as 1 and 23. No. 5 is somewhat different from the other three types, but approaches 6, 9 and 14 most closely, and so is shown on that diagram.

The average physical properties of the different zones are shown in the table on the following page.

Almost a casual glance at this table will show the great changes that have taken place in the tire due to the heat. In all cases, the tensile strength is lowered. In the darkened section, zone *B*, which, in places, occupies about half the area, the elastic limit has been raised over 25 per cent, and the elongation and reduction of area decreased over 50 per cent. Certainly if the physical qualities shown by the original material are within reasonable distance of what is correct

for tire steel, those in zone *B* should not be tolerated, and the 11 per cent decrease in tensile strength of zones *C* and *D* should at least be looked on with suspicion.

The Brinell and scleroscope figures are given in Figs. 4 and 9. Both of them indicate in a very striking way the differences in the zones, and the scleroscope figures in Fig. 9 show clearly the gradations in the zones before referred to. Both appear to be more nearly related to the elastic limit than to the tensile strength. It will be noted that the metal in the zones as laid out shows to be fairly uniform in any one zone, but that the zones differ quite widely from each other.

Zone *A* is very soft as it is composed of low carbon material, and no readings are given as they would not bear on the subject.

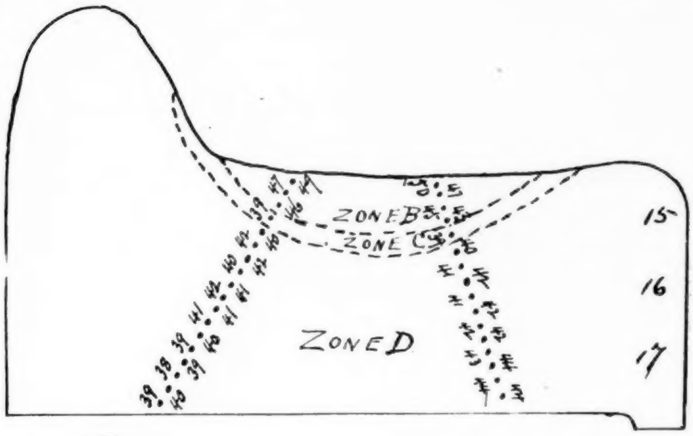
The metal in zone *B* is quite uniform, and is in harder condition than the rest of the tire metal. This is as would be expected, as the metal in this zone received a virtual quench.

The metal in zone *C* is necessarily less uniform than in zone *B*, as the condition of the metal in this zone varies somewhat from one side of the critical range (within which this metal was heated) to the other. This zone has the softest metal of any zone throughout the tire, as would be expected.

The metal in zone *D* shows the effect of the heating of the tire during welding and it has an effect of a more or less severe "draw" (by "draw" is meant a heating to and cooling from a temperature which is below the critical range). This metal may, therefore, be expected to show some lack of uniformity in hardness. If, however, the metal at approximately equal distances from the line of the critical range be compared, it will be seen that the hardness is as uniform as might be expected.

The average hardness of the different zones may be given as:

	Brinell	Scleroscope
Zone *B*	300	49
Zone *C*	248	39
Zone *D*	263	42
Original	265	44



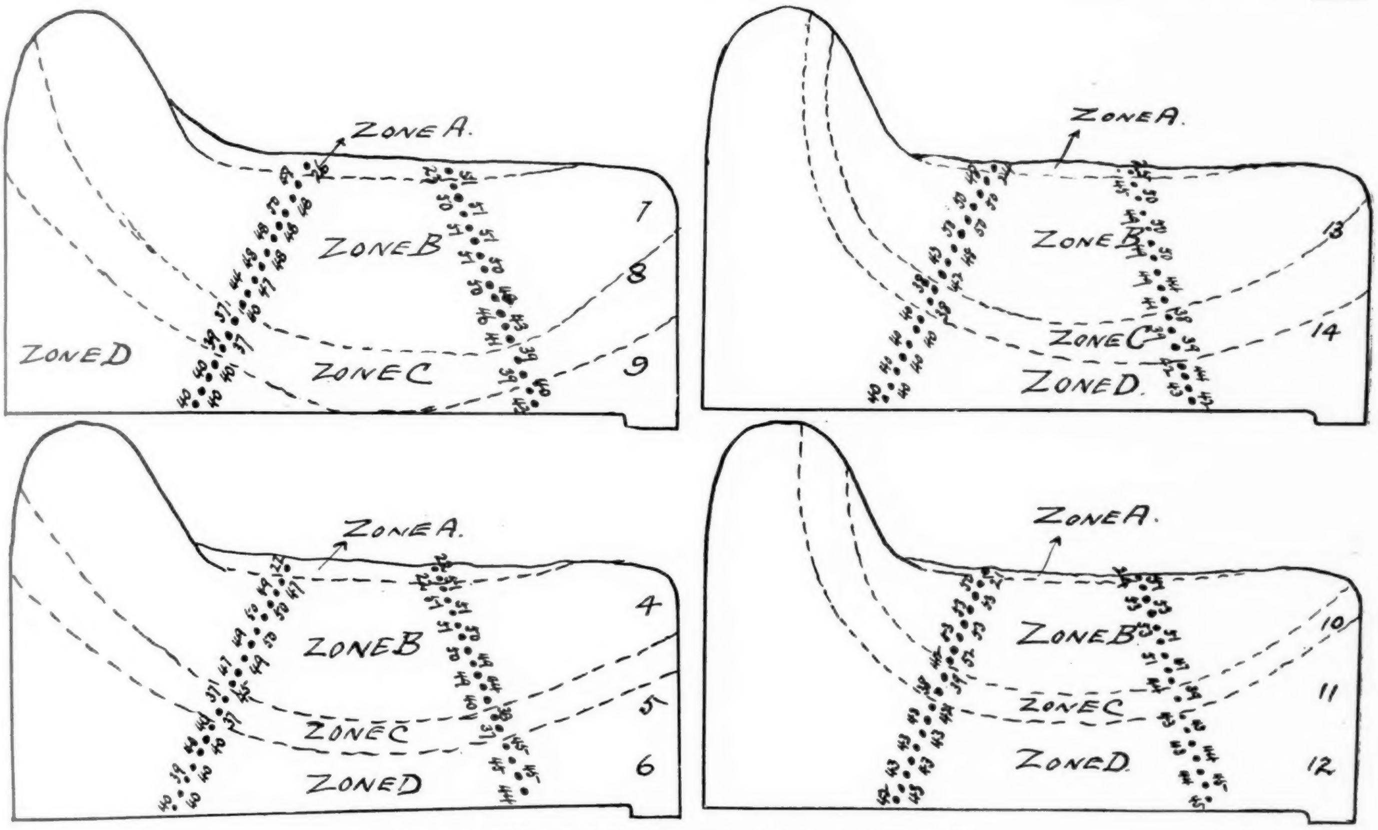


Fig. 9—Limits of Zones Determined by Hardness Tests.

MACRO- AND MICRO-STRUCTURE

Photomicrographs, Figs 10 to 30, show the structure of the test pieces 3-16 in. from the fracture, and of several spots located and numbered in Fig. 5. One series was taken at 430 diameters and another at 1,200 diameters. It is difficult, in some cases, at either of these powers, especially the higher one, to select a representative field, because of the great variation in even a short distance; but an endeavor was made to come as close to the desired result as possible, a number of photomicrographs being made from each test piece, and

Zone	Test pieces	Tensile strength	Elastic limit	Elongation in 2 in.	Reduction of area	Hardness Brinell	Hardness Scleroscope	Modulus of Elasticity	Modulus of Resilience
Original	1, 23	125,250	45.750	3.25 per cent	2.97 per cent	263	43	28,950,000	36.1
B	4, 7, 13, 15	120.900	57.700	1.50 per cent	1.45 per cent	298	49	29,990,000	55.9
C & D	5, 6, 9, 14	110,800	45.500	3.88 per cent	3.07 per cent	245	40	29,950,000	34.4

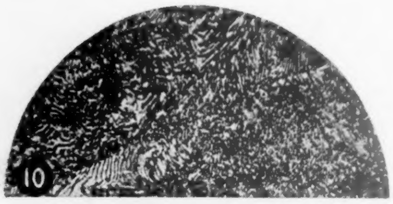


Fig. 10—Test Piece 1—430 Dia.

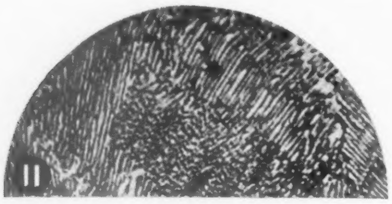


Fig. 11—Test Piece 1—1200 Dia.

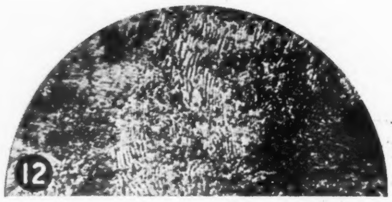


Fig. 12—Test Piece 23—430 Dia.

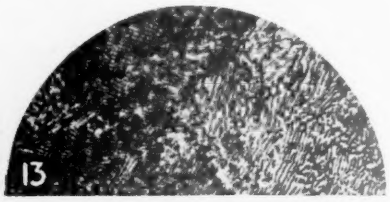


Fig. 13—Test Piece 23—1200 Dia.

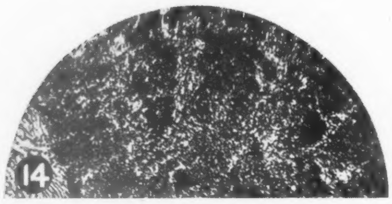


Fig. 14—Test Piece 15—430 Dia.

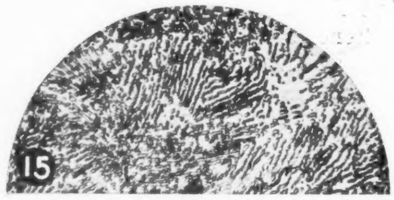


Fig. 15—Test Piece 15—1200 Dia.

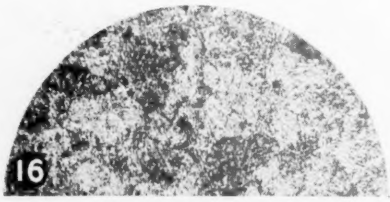


Fig. 16—Test Piece 5—430 Dia.

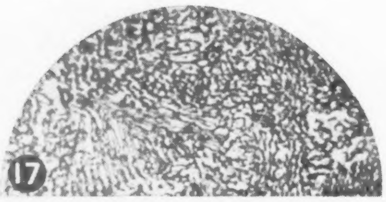


Fig. 17—Test Piece 5—1200 Dia.

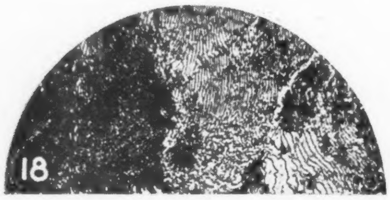


Fig. 18—Test Piece 6—430 Dia.

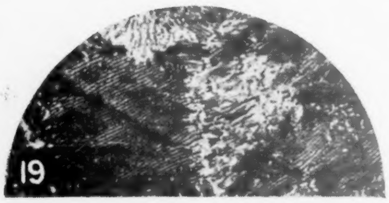


Fig. 19—Test Piece 6—1200 Dia.

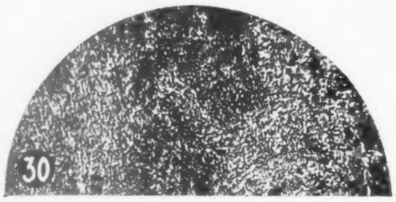


Fig. 20—Test Piece 9—430 Dia.

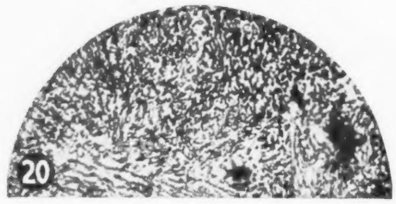


Fig. 21—Test Piece 9—1200 Dia.

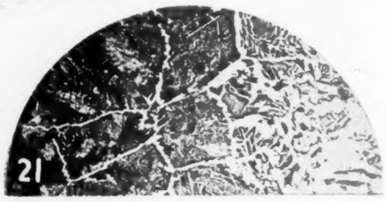


Fig. 22—Spot 2, Fig. 5—50 Dia.

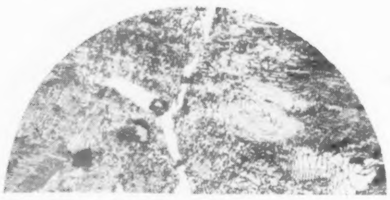


Fig. 23—Spot 4, Fig. 5—430 Dia.

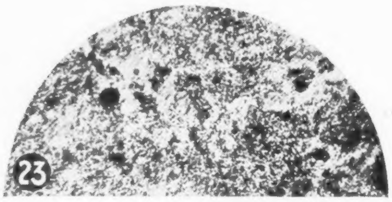


Fig. 24—Spot 5, Fig. 5—430 Dia.

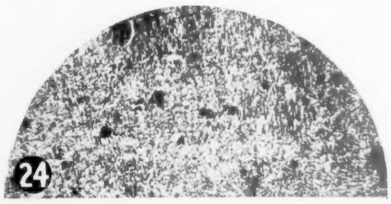


Fig. 25—Spot 6, Fig. 5—430 Dia.

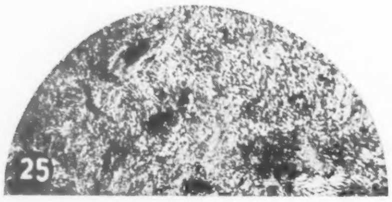


Fig. 26—Spot 7, Fig. 5—430 Dia.

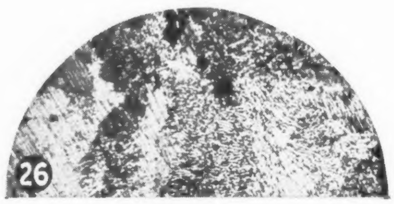


Fig. 27—Spot 8, Fig. 5—430 Dia.

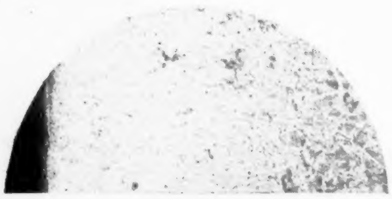


Fig. 28—Spot 10, Fig. 31—50 Dia.

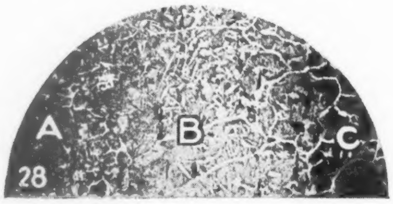


Fig. 29—Spot 11, Fig. 31—50 Dia.

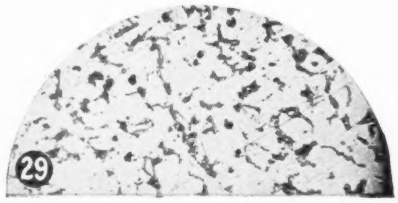


Fig. 30—Spot 12, Fig. 31—200 Dia.

Photomicrographs Showing Changes in Structure of Welded Steel Tires Due to Overheating.

the one appearing closest to the average being selected as representative. It was the aim to correlate, if possible, the physical properties and the microstructure, and although this can be done only in a general way, there seems to be a fair degree of correspondence.

The following table, using the nomenclature of Howe and Levy for the different varieties of pearlite,* gives a fair idea of the essential differences in the zones, and should be compared with Figs. 10 to 30.

Zone	430 diameters	1,200 diameters	Tensile strength	Elastic limit
B...........	Sorbite, sublamellar pearlite, ferrite.	Very fine lamellar pearlite, sorbite, ferrite.	120,900 lb.	57,700 lb.
C...........	Sublamellar pearlite, sorbite.	Sublamellar pearlite.	110,800 lb.	45,400 lb.
D...........	Sublamellar pearlite, sorbite.	Fine lamellar pearlite.	110,800 lb.	45,400 lb.
Original.....	Lamellar pearlite, sorbite.	Very fine lamellar pearlite.	125,250 lb.	45,750 lb.

It is interesting to note that the elastic limit in zones *C* and *D* varies but little from that of the original, while the tensile strength is much less. Howe and Levy† discovered that, under certain conditions of heating and cooling, steel of .92 per cent carbon loses much of its tensile strength, while the elastic limit is but little affected. It may be considered that the above figures tend to confirm this, although the temperatures and rates of cooling are not accurately known; also, the test pieces were taken crosswise of the tire, so that actual comparisons cannot be made. But it appears that breaking up of the cementite in the pearlite, or, in other words, deviating from normal lamellar pearlite, decreases the tensile strength materially, though it may not affect the elastic limit.

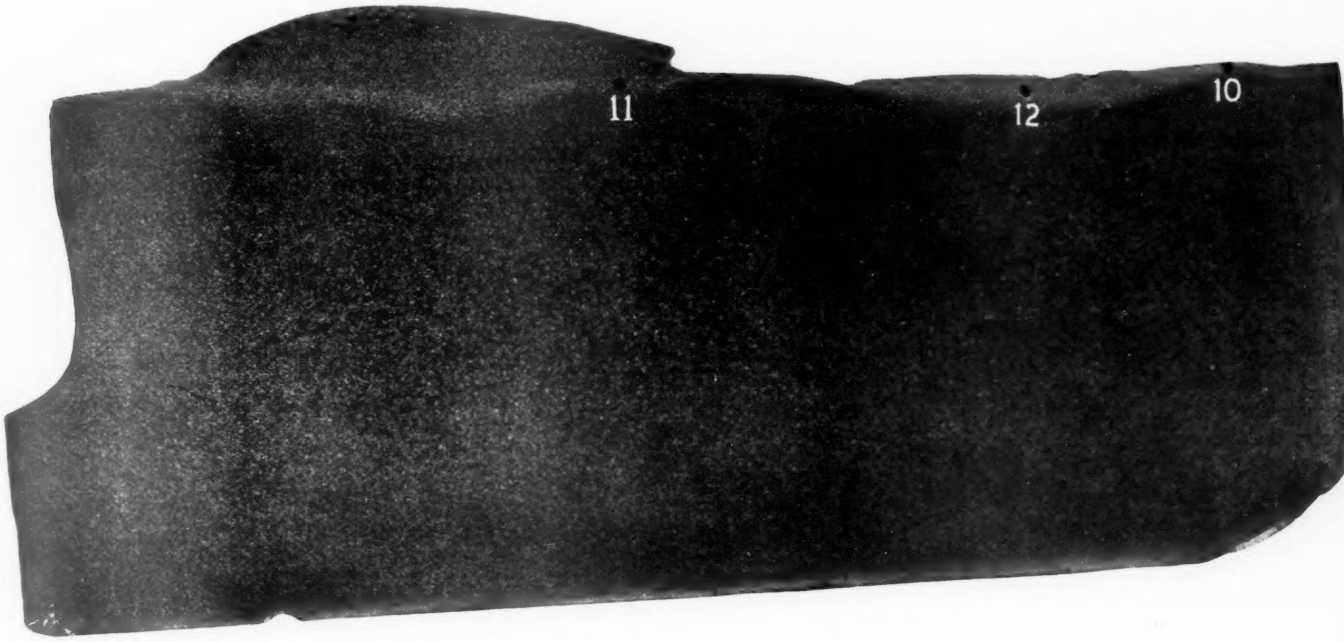


Fig. 31—Structure of Test Piece After Being Heated to the Melting Point—3.5 Diameter

The change in structure is well shown in Figs. 23, 25 and 27, at a magnification of 430 diameters, and should be compared with Figs. 10 and 12. They are taken from the section shown in Fig. 5, at the points marked 4, 6 and 8. At this magnification, the structure in Fig. 23 is much more sorbitic and also finer grained than that in either Figs. 25 or 27, and it would be expected that such material would be stronger, but more brittle, than materials typified by the other photographs.

It should be noted that, in zone *B*, there are frequent plates of free ferrite, which are rarely seen in zones *C* and *D*. Under higher magnification (1,200 diameters) the sorbitic parts shown in Figs. 23 and 27 usually resolve into lamellar pearlite, those in Fig. 27 being coarser than in Fig. 23. This can also be seen by comparing Figs. 10 and 12 with Figs. 11 and 13.

Zone *C*, Fig. 25, is practically free from lamellar pearlite and sorbite, and is composed almost entirely of what Howe and Levy call sub-lamellar and granular pearlites. It is very similar to Fig. 20. The intermediate zone, between zones *C* and *D*, consists of a mixture of the elements of the two zones, and is shown in Fig. 26, which shows both lamellar and sub-lamellar pearlites.

The transition zone between zones *B* and *C* as shown in Fig. 24, consists of a mixture of sorbite and sub-lamellar pearlite.

Fig. 28 shows the effect of simply heating the tire to the melting point, and Fig. 30 shows the change at a higher magnification, from which it would appear that the carbon has been reduced, at least in places, to about .4 per cent.

Fig. 22 shows the transition zone between zones *A* and *B*. The decarbonization of the original material is clearly shown by the white ferrite films around the grains in the left half of the photograph. The right half shows the added material.

This is another matter that militates against the use of any welding process in connection with tires. The heat, combined with the oxygen in the air, will certainly remove from the steel some of its carbon, thus making it unsuitable for tires. It might be thought that such a loss could be counterbalanced by using a higher carbon steel for the added material. But this is not possible entirely, and even then not beyond a certain limit, which limit is too low. For example, the simple melting of a piece of tire steel, before adding any material, produces a structure as shown in Fig. 31 at the right; while the use of drill rod containing about .9 per cent carbon results as shown in the same figure at the left.

It also appears that the higher the carbon, the greater the *proportionate* amount burnt out in a given time; i. e., if a .9 per cent carbon rod is used, the carbon will probably be reduced, as shown roughly by the microscope, to between .5 per cent and .6 per cent, or a reduction of about 40 per cent. There is certainly no such reduction in the case of .08 per cent to .10 per cent carbon steel.

Again, Fig 29 shows clearly that, in melting the tire steel,

*Journal of the Iron and Steel Institute, 1916, No. 11, page 220.
†Journal of the Iron and Steel Institute, 1916, Vol. II, page 233.

and adding .9 per cent carbon material, there are four zones; the original metal *A*, with its carbon content unchanged; the original material partly decarbonized by the heat, but not melted *B;* the original metal, melted and further decarbonized *C*, and the added material, partly decarbonized (not shown).

It is evidently not possible to change any of the last three zones to the same condition as the original tire metal, either with regard to grain size, carbon content, character of pearlite or physical characteristics. Therefore, it appears to the writer futile to experiment with different added materials, even if no damage of other kinds were done to the tire.

It is not believed necessary to elaborate other objections; but one point should be spoken of. While the writer is not familiar with all the torches on the market, yet none of those he knows of has sufficient capacity to make a sound weld in a tire 3½ in. thick without preheating the tire; and, of course, such treatment would have as bad, if not worse results, as the welding.

The following objections to fusion welding, as applied to tires, are the principal ones:

First: The physical properties of the tire are seriously altered by the heat applied.

Second: It is impossible that the added metal be of the same quality as the original.

Of course, the former is the more important.

Now it may be urged that the fusion welding of tires is a justifiable emergency measure under present war conditions. While the writer believes it a dangerous practice, it might be permissible in certain cases where danger would be a minimum, say in the case of switching engines in light service. But in times of stress in railroad service, temporary repairs are less useful than during periods of light traffic, because any accident causes worse congestion. And there is much more chance of loss of life when large numbers of people are being transported, as at present, than under normal conditions, from *any* kind of accident. So it appears that any practice carrying with it an element of danger, should not be permitted, especially during periods of stress and hard service.

Of course, it would be entirely possible to restore the condition of the heat changed parts of the tire to their normal state by proper heat treatment. There can be no objection to this, provided it is properly done. Practically no railroad shop has facilities for this work, although they could be readily provided. On the other hand, it is a question if the number of slid flat tires is sufficient to justify the installing of the apparatus necessary, and, under proper conditions of brake equipment, etc., there should be little of this trouble.

So that, everything considered, it is seriously a question if a practice attended with such possibilities of danger should be followed unless the heat treatment referred to can be accurately carried out.

WELDING TUBES IN THE FIREBOX

On page 35 of the January, 1918, issue of the *Railway Mechanical Engineer* appeared a sketch and a brief description of a method of welding tubes in the firebox tube sheets, which has proved successful in preventing trouble from honeycombing. Since the publication of the article referred to, our attention has been called to the fact that this method of welding in tubes was developed on the Chicago & North Western, and an application for a patent on the method was filed early in 1916.

THE TOTAL EXPORTS TO U. S. FROM ENGLAND IN 1917 had an aggregate value of $262,891,937, against $305,414,269 in 1916, according to a cable from the American Consul General at London under date of January 2.

TERMINAL TIME SAVING*

BY M. F. C.

Saving time is equivalent to conserving energy provided there is a storage capacity. To save two or three hours at a terminal by some adroit movement and then fail to turn the gain to a profitable account is like putting good money into a bad pocket. A device that really performs and actually reduces the cost beyond the peradventure of a doubt is the thing sought and we must take it into account. It at least deserves notice if not analysis. At this critical juncture when men and machinery are at a tremendous premium, an hour a day per locomotive is a big item and per car yet more. It represents 11 per cent of man's energy and a proportionate percentage of revenue to the railroad, for locomotives and cars are only earning money for the roads when actively engaged in service. Turning a locomotive, therefore from inactivity quickly to activity is doing a big bit toward production. The main money maker—the biggest single factor—the locomotive must be kept going in order to bring home results. For this main reason and obvious others, its every move should be studied.

Winter is a strenuous season for those at the terminals—a very decided taste of trench life. With congested engine houses and facilities generally inadequate, the outlook is anything but inviting. What can be done to improve these conditions and force our equipment into quicker service? About all that anyone can do is to prepare to take care of as many locomotives on the outside as it is possible to do. Extra inspection pits, invaluable things, an auxiliary steam line, air line and portable tools with work sheds here and there will add greatly to the convenience of the men from whom we reluctantly accept excuses. Pits are necessary adjuncts to an engine terminal and locomotives must be placed over them in order that the inspection and repairs be made properly. Sheds should be constructed to shelter the locomotives and repair crews. No mechanic can do justice to a job in a cold sleety rain with snow and slush up to his ankles. Pits of concrete and wood construction can be built rapidly and second-hand piping may be used for steam, water and air lines in emergency. By putting enough men on the job, shelters may be erected in a short time. Some large buildings have been built and made habitable at government camps in 3 to 4 days.

A locomotive coming in from its run should go first to the ash pit; from there it should go into the house and over the pit. After inspection the boiler should be blown out, washed and filled, and the necessary repairs made to the locomotive. There should be no interruption to these operations—if there is, the system is not working as it should. The coal and water should be taken after the locomotive has been repaired. There is no economy in taking coal and water sooner as the tank requires careful inspection as well as the engine. Caring for locomotives in the open at best is a questionable practice. It is altogether impracticable in extremely cold climates. It can be done in an emergency. It is greatly to be regretted that many engine houses and their adjacent track connections are so awkward and clumsy. Having to pass locomotives over the turn table to coal, ash or water is a sure indication that the layout is faulty. The shortest possible distance for accomplishing this turn around is the correct distance to be allowed. Much valuable time is lost due to the fact that locomotive movements are too roundabout.

I am fully aware that many of our engine houses are the products of engineers of the old school. I mean no disrespect to them—they wrought well with the problems of their day, but that day has departed, it is gone forever and we are face to face with the indisputable facts, powerful locomotives, abnormal labor conditions and business heaped

*Entered in the engine terminal competition.

up, and running over with antiquated facilities to contend with at many points. We want no more round houses, it is a modern round shop we require. To overcome these handicaps it is now necessary to study closely side stepping and backward engine movements of every kind and plan to move them in and out in as straight a line as possible touching the various points of contact indicated. It is entirely feasible to do this with wide awake energetic supervision; many miles may be eliminated by avoiding false moves.

The very practical question which is now before every motive power and transportation department is, how quickly can we return our locomotives to service upon arrival and what is the least time consumed for needed repairs. A boiler washing system in full operation will reduce the time as effectively as any single feature I know of. We cannot redesign the engine houses quickly and satisfactorily, but boiler washing systems may be put in on short notice. This will reduce the time from 2 to 2½ hours over the old hand method and cut down the boiler repairs enormously. While doing this by all means install a good big boiler so that there will be an abundance of steam for blower purposes. Much time may be consumed waiting on a weak steam pressure line. Have these boilers carry at least 125 lb. pressure. We have recently taken out a large healthy boiler in order to install one of a better sustaining capacity and high pressure. We are also putting in a number of additional washout systems at the extra busy points, each of which carries with it a 150 h.p. locomotive type boiler. By this method for example we are able to take care of 170 to 180 locomotives with a twenty stall engine house. It is nevertheless, a "nip and tuck," day, night and holiday proposition under ideal weather conditions.

A boiler washing system, locomotive cleaning device, inspection pits, a portable welding and cutting outfit, an abundance of steam and air, a well equipped tool room centrally located so that a tool may be had upon a moment's notice day or night, conveniently located grinders, drills and other machine shop tools will work wonders even at an old fashioned terminal. It has been stated by able men who have studied the matter that locomotives are in the hands of the mechanical department, being prepared to move tonnage 53.9 per cent of the time, therefore offer a bonus for a 15 per cent reduction of this and note the results for the next six months. If this does not revolutionize the old terminal, nothing will.

TESTS OF OXY-ACETYLENE WELDED JOINTS IN STEEL PLATES

In view of the big increase in the use of welding processes in firebox construction, recent tests on the strength and efficiency of oxy-acetylene welded joints in steel plates conducted by the Engineering Experiment Station of the University of Illinois and published in Bulletin 98 are of interest and value. The joints were welded by skilled workmen in a plant especially equipped for oxy-acetylene welding and the results are probably a little better than could be obtained under common shop conditions.

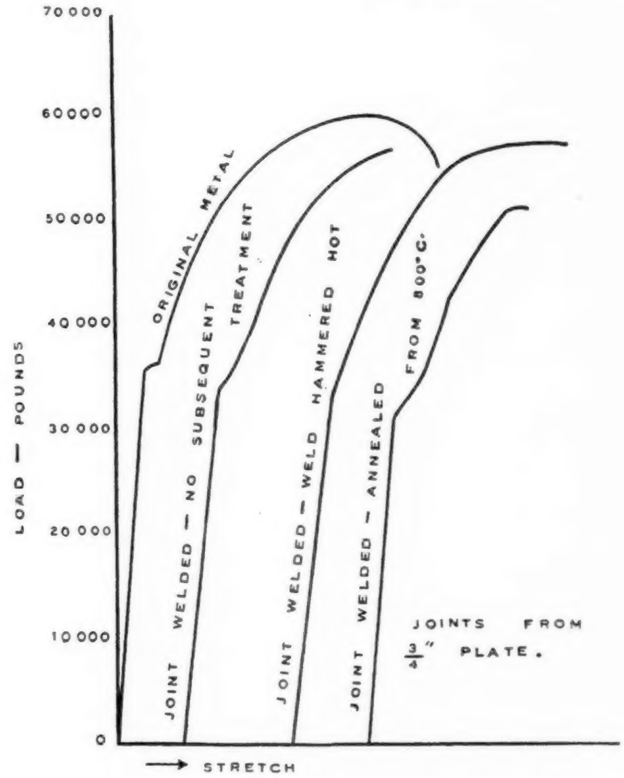
Laboratory tests were made under three conditions of loading: (a) Static load in tension; (b) repeated loads (bending) and (c) impact in tension.

The static tension tests give an index of the resistance of the welded joints to loads applied only a few times and without heavy impact. The repeated stress tests give an indication of the resisting power of the welded joints to loads repeatedly applied, such as loads carried by springs and axles. The impact tests give an index of the ability of the welded joints to resist sudden heavy shocks without complete rupture and high resistance to rupture under impact represents insurance against the sudden and complete failure of a part subjected to severe bending or stretching. This quality is of great importance in material for machine parts or for railway service.

The plates in which the test joints were made were steel with a carbon content of about .16 per cent and the following thicknesses of plate were used: No. 10 gage, ¼ in., ½ in., ¾ in. and 1 in. After welding, the plates were cut into test pieces and tested under the three conditions of loading as mentioned above.

Some of the comparative efficiencies are shown in the table, and the variations in yield point are shown in the chart.

A summary of the results is as follows: The tests were made on joints welded by skilled workmen and should not be considered as indicative of the strength of welds made in repair shops, or of welds made by workmen without special training in the use of the oxy-acetylene torch. For joints made with no subsequent treatment after welding, the joint efficiency for static tension was found to be about 100 per cent for plates ½ in. thick or less, and to decrease for thicker plates. For static tension tests, the efficiency of the



Stress-Strain Curves for Oxy-Acetylene Welded Joints.

material in the joints welded with no subsequent treatment is not greater than 75 per cent. The joints were strengthened by working the metal after welding, and were weakened by annealing at 800 deg. C.

The results of the repeated stress tests give an index of the inherent qualities of the joints and they follow in a general way the results of the static tests. For repeated stress tests the joint efficiency seems to be about 100 per cent for plates ½ in. or less in thickness, while the efficiency of the material in the joint is somewhat less. Hammering or drawing the welds while hot increases the strength and annealing from 800 deg. C. lowers it.

For static tests and for repeated stress the joint efficiency sometimes reaches 100 per cent, but the efficiency of the material in the joint is always less. This indicates the necessity of building up the weld to a thickness greater than that of the plate.

The impact tests show that oxy-acetylene welded joints are decidedly weaker under shock than is the original material; for joints welded with no subsequent treatment, the

strength under impact seems to be about one-half that of the material.

If the welded joint is worked while hot, the impact resisting qualities are slightly improved, although this does not make the joint equal to the original material in impact resisting qualities. Annealing from 800 deg. C. seems to have very little effect on the impact resisting qualities.

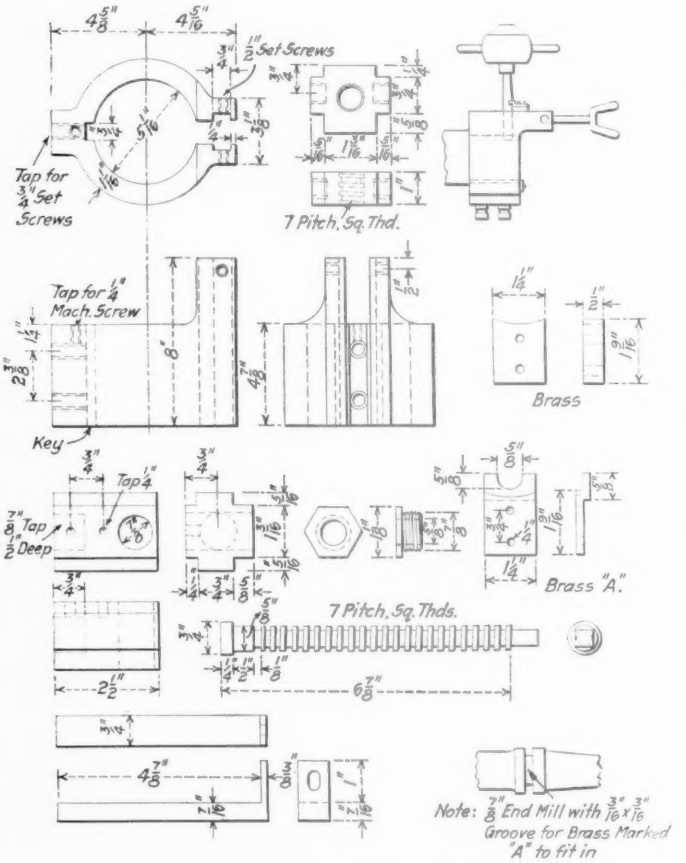
In general the test results tend to increase confidence in the static strength and in the strength under repeated stress of carefully made oxy-acetylene welded joints in mild steel plate.

EFFICIENCIES OF OXY-ACETYLENE WELDED JOINTS IN PER CENT

	Joint Efficiency		
	Static stress	Repeated stress	Impact
Thickness of plate	½ in.	½ in.	1 in.
Original material	100	100	100
Material of plate, annealed from 800° C.	89	84	89
Joint welded, no subsequent treatment	100	100	53
Joint welded, annealed from 800° C.	92	93	35
Joint welded, quenched, annealed from 800° C.	92	94	32
Joint welded, hammered while hot	101	107	58
Joint welded, hammered, annealed from 800° C.	95	102	53

DEVICE FOR MILLING KEYWAYS FOR ECCENTRIC ARMS IN CRANK PINS

It is difficult to secure the correct alinement of the keyways in crank pins and eccentric cranks if they are laid off before the crank pin is pressed in the wheel center. Many roads follow this practice, however, because of the difficulty of cutting the keyway after the pin is in place. The drawing



Details of Keyway Milling Attachment

below shows the details of a device that is used at the West Burlington shop of the Chicago, Burlington & Quincy for doing this work. It consists of a guide which fits over the end of the crank pin and is held in place by a key and two set screws. On the side of the guide opposite the key is a slot, at the end of which is a nut through which the feed screw passes. The outer end of the feed screw has a handle while the inner end fits in a bearing for the cutter. This bearing rests in the slot and can be moved back and forth by the feed screw. On the upper side of the bearing is a lug which fits in a groove in the milling cutter and regulates the depth of the keyway. The cutter is driven by an air motor as shown in the sketch of the assembled device.

A SHOP STORY WITH A MORAL

BY A TRAVELING AUDITOR

I recently had occasion to check a statement covering repairs to a locomotive, which included the application of a superheater, and I soon discovered that the distinction as drawn between additions and betterments and the operating charge was at too great a variance and that the figures would have to be rechecked and adjusted in order to satisfy the Interstate Commerce Commission.

Investigation of the method of determining the amounts developed that the shop employee at the close of his day's work made out a time slip on which he endeavored to show the hours put in on the various jobs during the day. He relied entirely on recollection. This system, I knew, would not come up to I. C. C. requirements as something more definite was needed.

On putting it up to the shop management to devise some other system whereby the figures would be more accurate, we were informed that there was only one way in which this could be accomplished and that was through the employment of a staff of clerks whose duties would be to follow through all operations wherein the additions and betterment charges were concerned. This proposed plan was put up to me for approval and I promptly vetoed it as I knew it could be worked out with the present organization and I made the statement that any additional men would mean money wasted.

My suggestion was to have the gang foreman in charge of the work keep track of the time of such of his men as were working on the addition and betterment job and to support my contention I offered the following argument:

The gang foreman knows just where to draw the line as between the addition and betterment and the operation charge. He is the man who orders the material and shows on the material ticket the proper charge; he is the man who lays out the work, that is, tells this or that man just what to do and he, therefore, would be in a better position to keep the time and distribution of the men than they would be, and if he would devote 10 or 15 minutes of each hour to this clerical work we could get a very accurate account of the charges.

Very plausible, indeed! In fact, so plausible and simple that I was immediately sent to the shop to organize for this work, and I will confess I was more or less conceited by the fact that my solution of the problem had been so readily accepted.

On arriving at the shop I found that the master mechanic was absent, so I went to the "next best," the general foreman of the locomotive department, with whom I was intimately acquainted. He proved to be a very respectful listener. I explicitly laid my program before him, explaining its advantages, the necessity for it, the expected result, etc.

I was ready to call the shop organization together and line them up, when the general foreman stopped me by saying, "I have listened with interest to this splendid theory of yours and I am going to ask one favor of you before you put it into effect. I want you to come to the plant at 7:00 a. m. tomorrow prepared to spend the day with us and follow just one suggestion of mine. It may be that the experience you get will cause you to slightly change your plans;

in fact, I want to put to test a theory of mine and that is that the average clerk is prone to inaugurate systems in shops without knowing the inside workings and if he were intimate with shop conditions he might hesitate."

I could see no harm in the suggestion and very promptly agreed, and was at the shop the next morning at the appointed hour.

"Here is my suggestion," said the general foreman. "As you know, we have 42 pits in the machine shop, divided into seven gangs of six pits each; one gang foreman to each gang. I want you to choose one of the seven gang foremen, report to him immediately, and follow him every minute of the day. Report to me your conclusions at the close of the day."

I followed this suggestion and incidentally followed the gang foreman of my choice for nine long hours. Between laying out the work for 53 men, including mechanics, helpers, handymen and apprentices, on six locomotives, making out requisitions for necessary material, going to the blacksmith, boiler and tin shop to rush material, following up an engine just off one of his pits, which was being completed in the roundhouse, answering questions of his and other men, signing up time sheets, approving distribution slips, keeping a record of the work going on so he could make a report in detail when the locomotives were repaired and making up two reports of this kind for locomotives recently completed, this gang foreman did not have a minute to spare in any one hour. He even lacked the opportunity to study his work, to plan what to do next and the most practical way of doing it, and as to squeezing in 10 or 15 minutes additional clerical work an hour—well, I very soon appreciated that a nine-hour day was altogether too short a time for the work already allotted to him.

At the expiration of the ninth hour, mentally and physically wearied, I reported to the general foreman by simply saying "You win."

He responded: "Mr. Blank, I knew I would, and I want to say to you, a representative of the general officers, that if any more clerical duties are put on my gang foremen, it will mean they will have to shirk one of two duties—that of repairing locomotives or that of clerical work."

Again I agreed with him as I had satisfied myself that he was absolutely correct. What I had seen set me to thinking. I began to ask myself several questions:

1. To what extent were we paying high salaries to men who put in a portion of their time performing minor clerical duties?

2. To what extent was the output from these men being hampered by the trifling duties constantly being saddled on them?

3. How many of the statements they were required to prepare were necessary and could not a number be eliminated; was the time put in on them worth while?

4. If the mechanical department supervisors were suffering from this, how about the transportation department, road department and others?

My little adventure at the shops bore fruit, however, as the report of my conclusions resulted in a vigorous campaign throughout the entire railroad, with a view of eliminating or reducing, so far as possible, the clerical duties of lead men, as well as reducing or eliminating statements and reports from all departments regardless of the duties of the men making them.

The first step in this campaign was the appointment of three senior clerks in each department—three men from the traffic department, three from the mechanical department, three from the transportation department, etc., who were thoroughly familiar with the various needs of their department, insofar as reports and statements were concerned.

After the committees of three had concluded their departmental investigations, which resulted in many reports being entirely eliminated, a number of others reduced and in all possible cases the duty of making reports placed on non-productive labor, namely clerks, the several committees got together to investigate the necessity of certain reports made by one department to another. This resulted in a further elimination.

The reduction in work of this nature was astonishing and one wondered what conditions brought about so much unnecessary data. The committee with which I was connected concluded that in the majority of cases this condition was brought about by transfer of a department head to some other point or department. In his last position he was receiving a certain statement, drawn up in a certain manner and it was very natural that he should want similar information—but never a thought would be given to statements regularly coming in for which he in his new position had no use

Another contributing factor was discovered. A statement would be inaugurated to cover a change in standard and a monthly report would be requested in order to keep a line on the change; the change would be brought about, but for months and even years the same statement would be furnished, with nothing to report. The information required was an absolute necessity at the time the report was inaugurated, but although this necessity had long since ceased to exist, there was a hesitancy to discontinue the statement "for fear someone would some day want it."

Another benefit of our campaign, which is not to be scoffed at in these days of high prices, is the saving in stationery. A sheet of paper saved here and there, in the aggregate most certainly effected a decided economy.

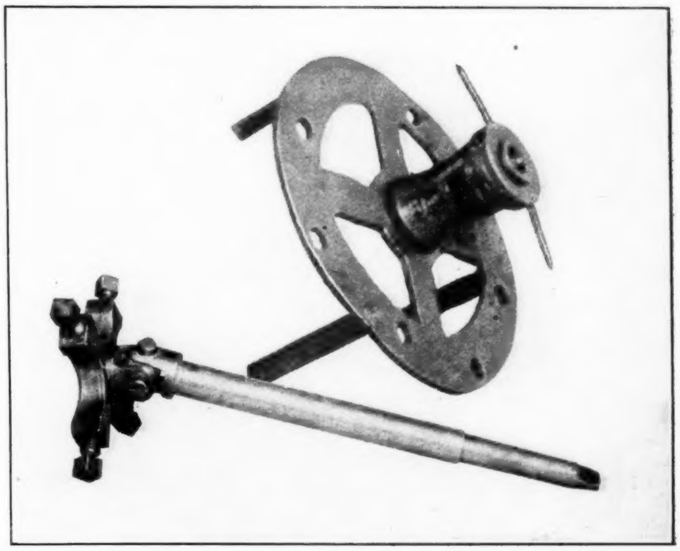
The campaign apparently has had a lasting effect, because to this date the evil of unnecessary statements and reports has failed to crop out.

This subject should be food for thought to all who have overlooked this important feature of non-productive effort, common to all railroads.

As to the moral—well, there are several.

GRINDING SUPERHEATER HEADER

The work of grinding the steam pipe joint rings on superheater headers is usually done by hand and is a slow and tedious job. The device illustrated below was developed



Device for Grinding Superheater Joint Rings

in the Clinton, Iowa, shops of the Chicago & North Western to make it possible to grind these joints with an air motor. The ring is held by set screws on the chuck which is attached to the spindle by a universal joint. The frame

is arranged so that it can be bolted to the flange of the header and has an eccentric bushing through which the spindle passes. In operating the device the spindle and frame are placed in position and an air motor is attached to the spindle. Then by revolving the eccentric bushing by means of the short handles in the outer collar while the spindle is driven by the motor, the ring is moved over all parts of the joint on the header, producing a smooth, true surface.

REDUCING THE TIME TO TURN LOCOMOTIVES*

BY T. T. RYAN
General Foreman, Atchison, Topeka & Santa Fe, Las Vegas, N. M.

To get a locomotive over the road promptly, to get the crew off and the engine house crew on it promptly, to handle it in modern time across the cinder pit, past the coal dock, have it cleaned and inspected and put in the engine house and then to have it promptly and properly cared for, got hot and started back on another trip constitutes the sole reason for building expensive terminals or engine houses.

Careful handling of trains by the despatcher which results in a train getting over the road does as much toward keeping locomotives in shape to turn promptly as any other one thing. If we follow the despatcher and trainmaster closely and get them to understand how by avoiding side track delays they may help and explain to them the damage caused by thus holding trains, we will find that they will do all they can to help. We are prone to criticize these men too much anyhow; it would be vastly more to the point if we would spend some time with them and help them to construct a better policy than to continually criticize them. If it is necessary to criticize let it be constructive.

The time at terminals may be reduced by greater effort on the part of employees to make the best use of the available facilities and it may also be reduced by providing modern facilities to take the place of those that are out of date.

The first method is immediately available at all places regardless of whether the facilities for turning engines are modern or not. It only requires the right kind of supervision and enough of it. Railroads are about the only concerns that have been inclined to work with a minimum of supervision and it is likely that this is a relic of the time when all the workers were more skillful, more versatile, and approached their tasks in a different frame of mind than they do nowadays.

There are today many modern terminals for turning locomotives that leave little if anything to be desired in the way of facilities. With these there is nothing needed except to systematize and speed up the work. There are many though, and often ones of importance that have badly arranged tracks, poor coaling stations, hand operated cinder pits and cold water washing plants, together with utterly inadequate tools for doing the mechanical work required.

LOCATION OF TRACKS

The tracks should be so located that the method of approach or routing will be direct and continuous past the cinder pit, the coal chute, the water cranes, the cleaning shed, the turntable to the house.

When in the course of the performance of these operations it is necessary to shift the locomotive from one track to another or around other locomotives or to delay the inbound locomotives on account of outbound locomotives valuable time is lost that cannot be regained. It is not uncommon to find locomotives standing outside the terminal for hours after their arrival at a terminal on account of lack of room. A terminal that handles thirty locomotives per day and loses only an hour on each has lost one locomotive for three ten-hour days or at fifteen miles per hour has lost the movement of a tonnage train four hundred fifty miles. Multiply this by the terminals in the United States and see what the figure leads to. Or put it another way. There are approximately 70,000 locomotives in the United States; let each locomotive lose an average of two hours out of the twenty-four and note the result. At ten miles per hour each locomotive has lost twenty miles or a total loss of 1,400,000 engine miles per day.

CINDER PIT

The next point of consideration should be the cinder pit. We have at many places, in fact in the majority of places, hand operated cinder pits. There is no question that these pits cost a great deal in time lost and in money expended for labor. Take a point turning 1,200 to 1,500 locomotives per month. It is certain to take at least two shifts of four men each to handle the cinders. This will figure at the very least at the present time $16 per day to handle the cinders without allowing anything for the extra hostler force necessary to handle the locomotives on account of the fact that the locomotives cannot be moved quickly.

Cars are difficult to secure for the cinder pit and too often we find locomotives delayed because cars cannot be obtained. Still more often we find that locomotives are not being gotten in the house for repair because the force on the cinder pit is down to one man. Who has not been a night engine-house foreman and on coming to work at seven p. m. been greeted with the information by his hostlers that the cinder pit was full and the night men had not shown up for work. Then he has had to go and take the wipers or laborers out of the enginehouse and send them to the pit with the result that important other work had to be left undone.

There is another way that this causes the loss of not only time but money as well; locomotives are delayed at the cinder pit and on this account it is often necessary to call day men back at night paying them extra money for a poorer grade of work than would have been done in the day time. I think that every man who has run an enginehouse will agree that overtime work is undesirable from every point of view. The workman who has performed a hard day's labor is in no shape to come back at night and do good work and still less is he able to come to work again the following morning and do good work throughout the day. The vast majority of mechanics do not want to work overtime.

It is a refreshing fact, however, that our progressive general managers and mechanical superintendents today are seeking and installing the best there is to be found in the way of mechanically operated pits that do away with the trials of a hand operated pit.

COAL CHUTE

The next step in natural order is the coal chute. It should be also of modern type to avoid delay and it is well to operate the coal chute and the sandhouse in conjunction with each other. Any of the modern plants are good and all of the old type pocket chutes are bad; they consume unnecessary time and time is the greatest asset that we have at the present.

That the modern coaling systems are necessary is so well recognized that a discussion of them would seem superfluous.

The water cranes should be installed to avoid any delay in taking water due either to capacity or to having to shift the locomotive from one track to another. The writer has seen a plant with the coal dock on one track, the cinder pit on another and the water crane on still another, making three tracks that the hostler had to put the locomotive on before it finally arrived at the enginehouse.

CLEANING

During recent years since the advent of modern power, locomotives have been wiped; they have not been cleaned.

*Entered in the engine terminal competition.

Mechanical cleaning is coming and it is coming to stay. Mechanical men are recognizing that locomotives to be kept in first class condition must be clean so that they can be inspected and so that the men can work on them. In addition to this, labor is becoming so scarce and costly that we cannot afford to tie up a large number of men to wipe locomotives which may and should be cleaned by one-twentieth of the present number.

It would seem that the proper place to clean a locomotive would be outside the enginehouse and it should not consume over twenty minutes. Why should we take a locomotive in the house and clean it and then hire men to haul the dirt out? Would it not be vastly better to clean the locomotive outside and avoid this extra expense and at the same time eliminate that curse of every enginehouse foreman namely, wet and dirty pits.

WASHING BOILERS

Every point that washes a boiler should have hot water to wash with. Cracked sheets, leaky flues, delayed traffic, broken staybolts, are only a few of the evils attendant on a cold water washing system. Properly handled with a cold water plant we may not expect to cool a large modern locomotive, wash it, fill, fire and get it hot in less than eight to ten hours' time. Properly handled or not, we will not beat this, for if we do not handle it properly we will damage it so that in the end we will hold it out of service long enough to make repairs to bring the average up to this figure. With a proper hot water washing plant the boiler should be washed and made hot in four hours. To figure the saving is a simple mathematical proposition.

REPAIR GANGS

The work of the repair gangs is a matter of organization, and so handling the work that it will proceed in a regular and orderly fashion; so well systematized that each necessary repair will follow in its proper place with a minimum of delay to the others. Each regular and standard operation should be assigned to some one assigned to that particular duty who will be held responsible for its performance.

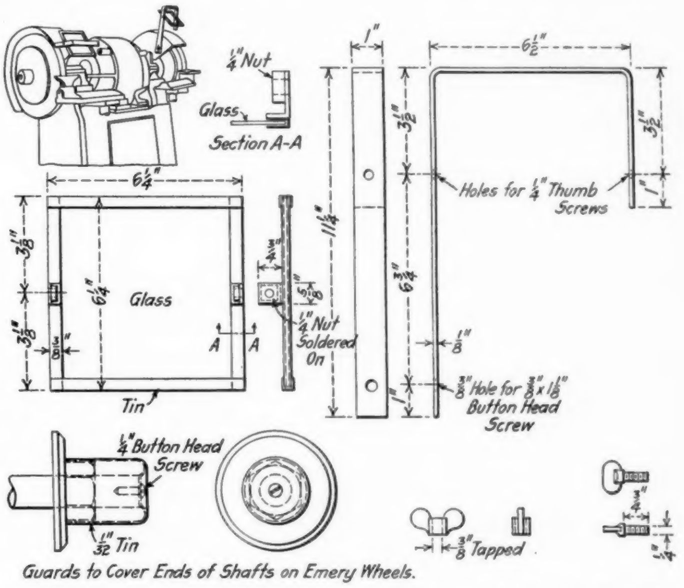
Proper tools to do the work should be provided and the work should be done in the quickest and least expensive way. The tools should be cared for and be kept available at all times.

In conclusion: We may reduce the time that is being taken to turn locomotives now by a large per cent without the outlay of money and at the same time increasing the output simply by re-organizing the forces where necessary and by finding a way to inspire the workmen with the zeal. Having done this, having cut out all lost motion, the rest we gain must be done by adopting improved methods. This calls for an initial outlay of money but the saving to be effected will more than justify it.

Million and a Half Soldiers Moved by Railroads.—Figures compiled by the Railroads' War Board indicate that the railroads of this country have safely transported approximately 1,500,000 soldiers to training camps and embarkation points since August 1. One-third of these men have made journeys necessitating overnight travel and have been moved in tourist or standard sleepers. On one of the long hauls 8,000 men were moved from a training camp on the western coast to a point on the eastern coast—a distance of 3,700 miles—in a little less than a week. The men traveled in 16 sections, each section comprising 12 tourist cars and 2 baggage cars. As a result of co-operation between the government, the railroads and the Pullman Company, 500,000 soldiers have been spared the discomforts of making long trips in day coaches. To assure the safety of the men in transit, the railroads have adopted an average speed of 25 m. p. h. for all troop trains except when freight cars are included in trains. The speed is then reduced to 20 m. p. h.

GLASS SHIELDS FOR GRINDING WHEELS

The practice of supplying goggles for the use of workmen while grinding tools is followed by many roads. It has certain disadvantages, however, as the expense of furnishing goggles to all employees who grind tools is a considerable item and men are apt occasionally to neglect to use them. For these reasons some roads prefer to protect the men using grinding wheels by a shield on the machine itself. An ef-

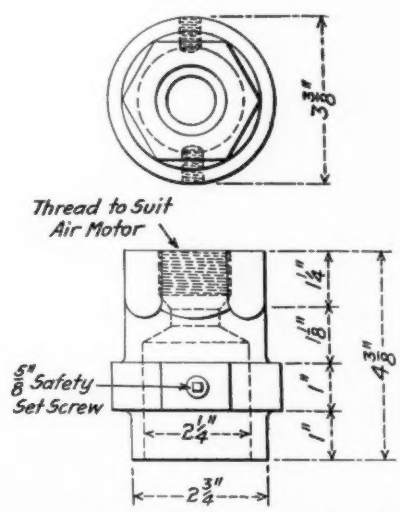


Safety Devices for Grinding Wheels Used on the North Western

fective device for this purpose, which is in use on the Chicago & North Western, is shown in the illustration. It consists of a movable arm attached to the grinding wheel shield carrying a frame which holds a piece of glass 6 in. square. The glass can be set at any angle desired, which makes it possible to bring it in a position where it will afford protection without interfering with the view of the piece being ground.

REMOVING BOILER TUBES

The appliance illustrated below, which is used at the Clinton shop of the Chicago & North Western, has been



Socket Used with Air Motor for Removing Boiler Tubes

found effective for removing boiler tubes when they cannot be passed through an enlarged hole in the tube sheet. It can be attached to an air motor of either the standard or close-quarter type. When the tube has been cut off it is driven a short distance through the front tube sheet, the

socket is placed over it and the set screws are tightened. The tube can then be revolved by the air motor, thus readily removing the scale as the tube is drawn out.

CLAW BAR DIES

BY F. B. NIELSEN
Blacksmith Foreman, Oregon Short Line, Pocatello, Idaho

The set of dies illustrated below for the making of claw barsbars of material from the scrap pile.

By the use of these dies, considerable saving is being effected in the Pocatello shops. The claw bar, which is shown in Figure 3, has a machine steel shaft with a crucible tool steel claw, and was formerly purchased at a cost of $1.95. Our claw bars are now made with the dies at a cost of 70 cents each, utilizing scrap tire steel for the claws to which are welded handles from the discarded claw bars.

A large number of scrap tire steel claw bars were furnished the trackmen without informing them as to the change in material and our observations, covering a considerable period of time, have indicated very conclusively that the reclaimed bars are proving satisfactory in every respect.

The operation of making these bars, which are all formed under steam hammer, is as follows:

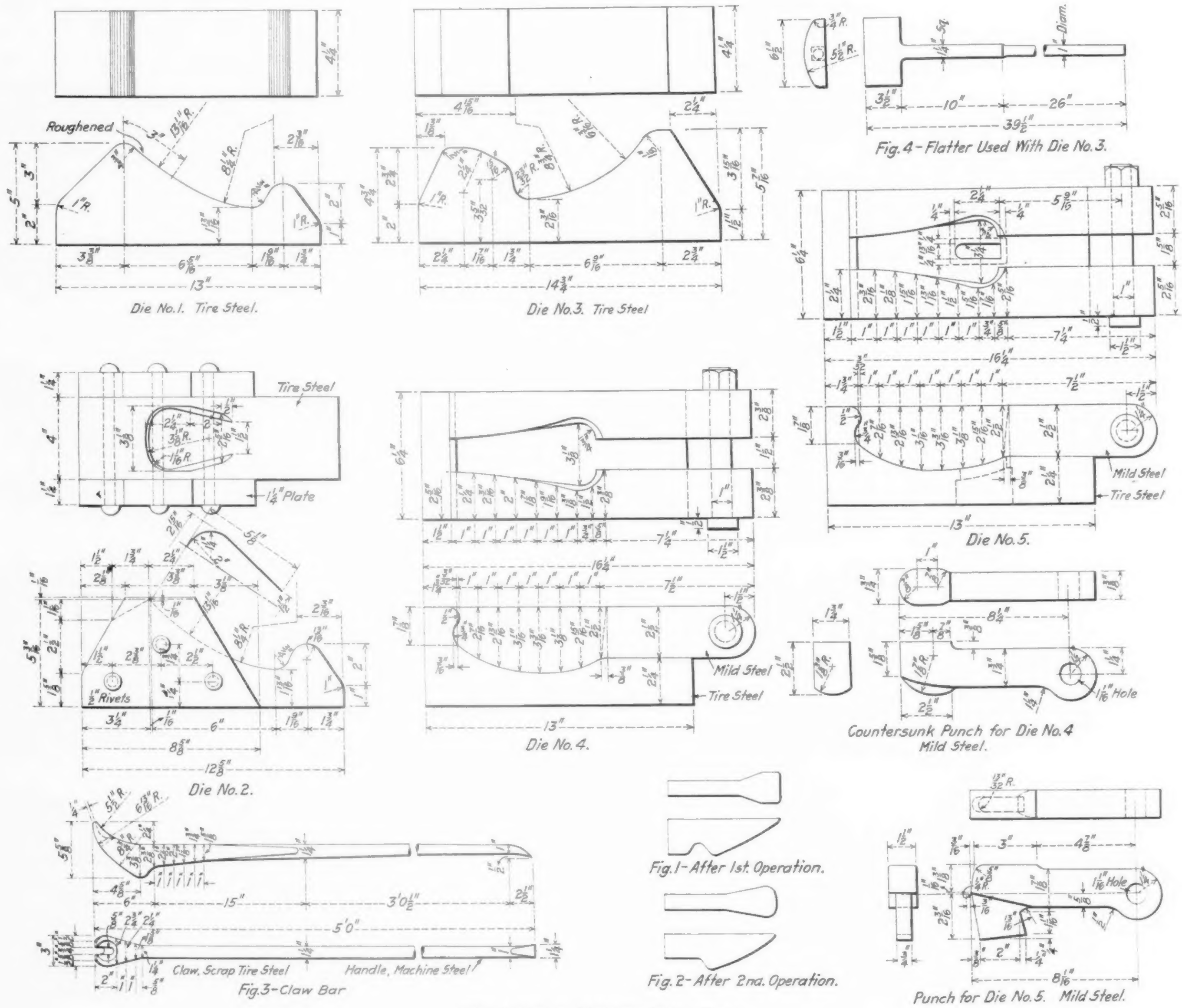
Operation 1.—Obtain a bar of scrap tire steel 1½ in. by 3½ in. by 11 in. Heat and place one end on the tip of die No. 1 and hammer down until it takes the shape shown in Fig. 1. Note that die No. 1 is roughened for a distance of 3 in. from the tip which prevents the bar from slipping.

Operation 2.—After heating, place the material in die No. 2 which rounds off the end as shown in Fig. No. 2. Then, while the bar is hot, draw out the foot to take the shape shown in Fig. 2. The two 1¼-in. plates riveted on the sides of die No. 2 and extending above the tip 1/16 in. prevents injury to the die during the cutting off operation.

Operation 3.—Again heat and place the material in die No. 3, which, with the use of the flatter shown in Fig. 4, gives the 5½-in. radius to the claw shown in Fig. 3.

Operation 4.—After heating, place the bar in die No. 4 and strike the countersunk punch which swings on the 1-in. bolt. This countersinks the claw for the spike head.

Operation 5.—Again heat and place the bar in die No. 5, which, with the punch, forms the ¾-in. slot in Fig. 3.



Dies Used in Making Claw Bars

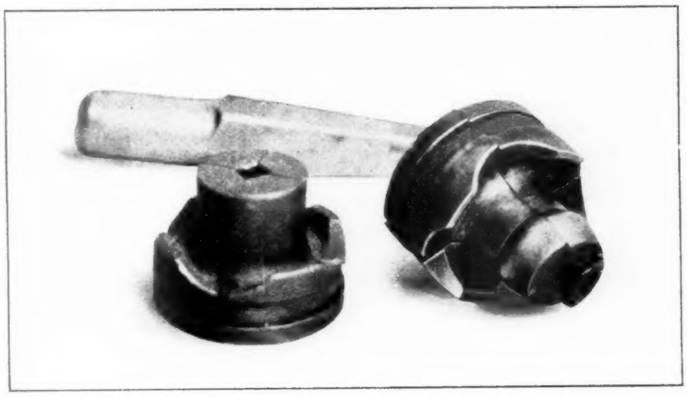
Operations No. 4 and No. 5 can be performed in one heat, but it is not recommended as it is liable to injure the punches. The claw and the old handle from the discarded claw bar are then scarfed and welded together.

The dies themselves were made from scrap tire steel, except the top part of dies No. 4 and No. 5 and the punches which were made of mild steel.

NEW DEVICES

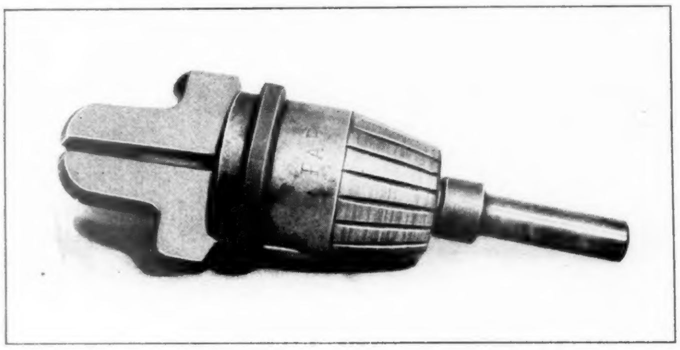
NEW DESIGNS OF BOILER TOOLS

A beading tool which differs radically from the type ordinarily used has been developed by William Kerr, boiler foreman of the Chicago & North Western, at Clinton, Ia. This device, an illustration of which appears below, has two blades with shoulders shaped to the outline of the bead on the tube. These blades are held in the body of the tool by a



Projections on the Expander Sections Prevent Injury to the Tubes

rubber band and are separated slightly by a rubber block placed between them. The shank, which fits the air hammer, is made separate from the body. In operating the tool it is held in line with the tube and revolves while the air hammer is operating. It is claimed that tubes can be beaded in from 15 to 20 seconds with this device. The tool cannot be held at such an angle that the blades will injure the tube



A Self-Alining Beading Tool

sheets, as is often done with the common type of beading tool. By providing bodies of different sizes the same blades can be used for both the small tubes or for the larger superheater flues.

Another tool designed by Mr. Kerr is a new type of sectional expander. The straight expander is shown at the right in the illustration and the Prosser expander at the left. It will be noted that both styles have projections at the outer edges of the sections. These bear against the flue sheet when the expander is in use so that the shoulder of the expander will not be forced against the projecting end of the tube when the pin is driven in. This prevents the weakening of the flue at this point and forcing the bead away from the sheet when the expander is used repeatedly. Both of these devices are handled by the Collis Company, Clinton, Iowa.

PORTABLE VISE STAND AND PIPE BENDER

A vise stand and pipe bender which is portable and can be used without being fastened in place has been put on the market by H. P. Martin & Sons, Owensboro, Ky. It is adapted for use wherever a stand is required on which pipes or conduits may be bent, threaded or cut.

The stand is made of No. 16 iron reinforced with mal-

Martin Portable Vise in Use

leable castings. The legs are pieces of 3/4 in. pipe and fit into pockets in the stand. Either a hinged pipe vise or a vise of the chain type can be furnished with the stand. On the side opposite the vise there is a special patented pipe bending fixture which also serves as a support for the pipes placed in the vise. The side braces provide a convenient place for tools.

The stand can be disassembled quickly and makes a compact bundle. It weighs only 45 lb. and can readily be moved from place to place. Though light in weight it is rigid and does not require fastening to the floor as do most vises of this type. The legs are arranged so that they are not in the way when short nipples are being threaded. Pipes of all sizes up to 2 in. can be handled on this stand. If

desired, any part of the complete outfit can be supplied separately. This device is now in use on several railroads.

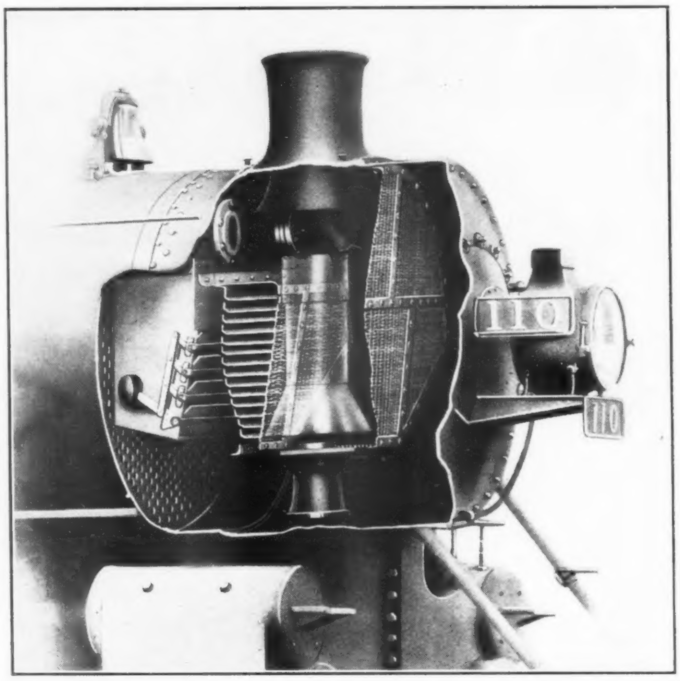
LOCOMOTIVE FRONT END SPARK ARRESTER

A new type of locomotive spark arrester has been developed and patented for both anthracite and bituminous coal burning locomotives by I. A. Seiders, superintendent of motive power and rolling stock of the Philadelphia & Reading. During the past two and one-half years it has been applied to 474 locomotives, 390 of which have wide fireboxes and burn anthracite coal, and the remainder have narrow fireboxes and burn bituminous coal. It is claimed that this spark arrester will not appreciably reduce the steaming qualities of the locomotive and a statement has been made that by its use the fire claims have been reduced 40 per cent.

The sectional photograph shows the device applied to a locomotive with a superheater, and the drawing illustrates the application to a saturated steam locomotive. The principal features of this spark arrester consist of a "breaker plate" made up of a slotted plate fitted with deflecting veins, which is applied in line of the flue gases ahead of the front flue sheet. This breaker plate tends to break up the largest sparks before they strike the netting. The horizontal diaphragm table plate is perforated with 7/32-in. holes and the side sections are inclined, being attached to the sides of the smokebox. This type of diaphragm reduces the amount of resistance to the draft and adds to the self-cleaning characteristics of the front end. The horizontal table is made up of 1/8-in. material, being 26 in. square. It is perforated to permit of better entrainment of the gases without decreasing the size of the exhaust nozzle and rests on a flange at the top of the nozzle tip. The blower pipe is fitted into the exhaust nozzle below the table line.

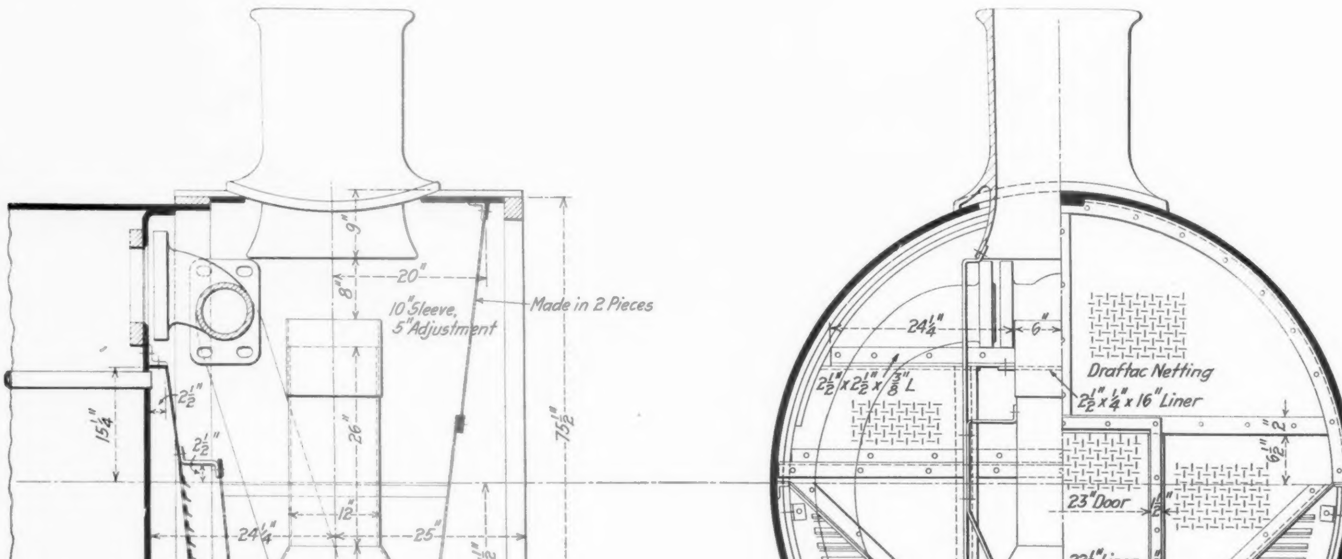
exhaust. The plate around the steam pipes is so secured that it will not vibrate, opening up holes for sparks to pass through.

The joints in the netting are so made that no openings



Application of Spark Arrester to a Superheater Locomotive

can occur to permit the passing of unduly large sparks. All nettings and plates are bolted at the side to a 2-in. angle iron which is riveted to the smokebox.



Arrangement of the Spark Arrester for Non-Superheater Locomotives

The side table plates are inclined, as shown in the illustration, to prevent the collection of cinders. The fine particles fall to the bottom of these plates on top of the perforated horizontal table and are carried out of the stack by the

The front netting and plates are arranged in separate parts with ample support at their intersections, as shown in the illustration. The center plates may be easily removed when it is necessary to work on the flues, making it un-

necessary to remove the entire front end netting or the table.

The spark breaker plate, located directly in front of the tube sheet and back of the front end netting, is secured to the flue sheet over the top row of flues under the T-pipe. It has 16 pressed steel openings 1 in. wide and pressed out ½ in. away from the plate for the full length of the plate. Its purpose is to break up the sparks, permitting only the finer particles to pass through the netting in front of it. The larger particles will travel to the front of the smokebox and in their passage be reduced sufficiently to pass through the netting.

The netting used with this device has an oblong opening 3/16 in. by ¾ in. In the front end, shown in the drawing, the open area of the breaker plate is 462 sq. in. and the entire netting area has an opening of 1,607 sq. in. or 11.17 sq. ft.

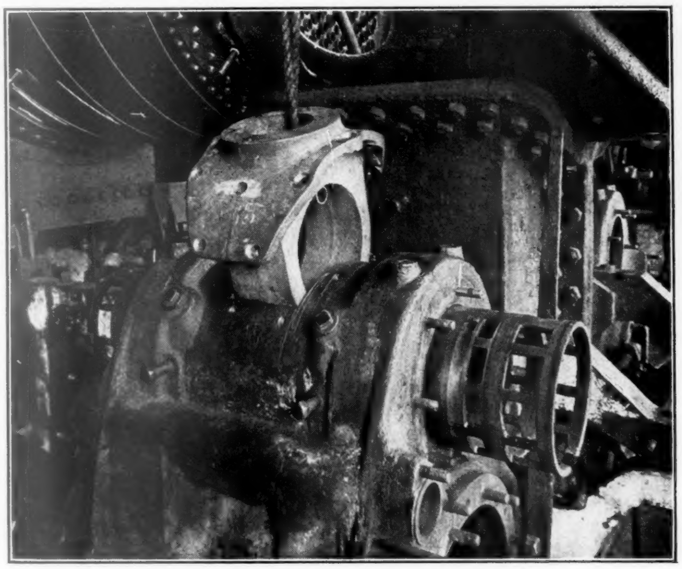
Due to the large opening it will not be necessary to reduce the size of the nozzle to provide the proper draft. In this way it will provide greater economy in fuel.

This front end arrangement has reduced shop maintenance costs due to its self-cleaning qualities. It is simple in construction, strong and durable, and reduces the number of leaky joints in the netting commonly found on locomotives.

METHOD OF APPLYING OUTSIDE STEAM PIPES

An arrangement for applying outside steam pipes to locomotives with inside steam pipes and piston valves has been patented by the Locomotive Appliance Company, Chicago. The device is designed to overcome troubles due to leaky steam pipes and cracked cylinders. The parts required for its installation are now being sold by the company to railroads.

The device consists of a yoke casting for the valve chest



Fitting Yoke Casting to Steam Chest

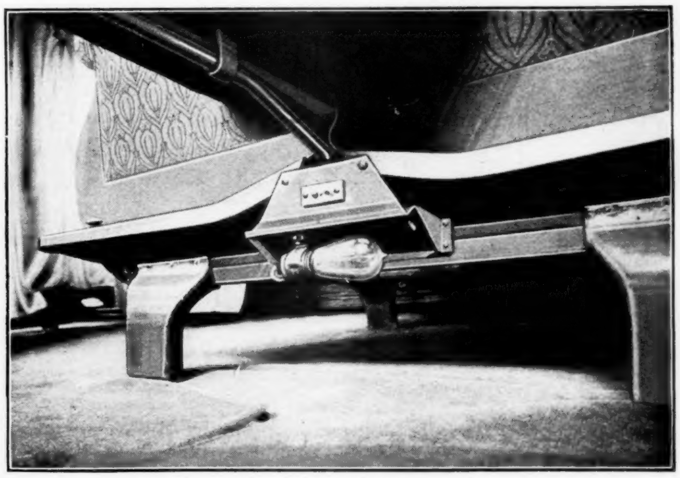
and flanges to fit around the steam pipes where they pass through the smoke box. It is also necessary to provide steam pipes which will fit the outside connection on the steam chest, and valve chamber bushings long enough to extend into the yoke. In applying the device it is first necessary to cut the steam chest to receive the yoke. When placed in position the horizontal passage through this casting is directly in line with the valve chamber bushings. The yoke is then bored out and the bushings pressed in from both sides to make steam tight joints. It is not necessary to have the joint between the yoke and the steam chest tight as there is no pressure at that point. After the yoke and the valve chamber bushings have been applied it is the usual practice to fill the live steam passages in the cylinders with a mixture of cement and iron turnings. The outside steam pipes are applied in the usual manner, a gland being used where they pass through the smoke box, in order to secure a tight joint.

This device is used not only to reclaim cylinders but also to substitute outside for inside steam pipes. Some roads consider that the advantages to be derived from the change fully justify the cost on account of the large amount of trouble experienced due to leaks at the bottom joint on inside steam pipes, resulting in a waste of steam, inefficient combustion and loss of service from locomotives. One road that is now applying outside steam pipes to large numbers of engines found by testing inside steam pipes on locomotives in service that 90 per cent of them showed leaks at the bottom joints.

NIGHT LIGHTS FOR PULLMAN CARS

The Pullman Company has been experimenting for some time with various lighting arrangements designed to provide suitable illumination for the aisles of sleeping cars after the passengers have retired. A satisfactory installation has recently been developed and is now being applied to all new cars built and also to cars which pass through the shops for repairs.

It may be of interest to give a few details of the numerous installations which were tried before a method of lighting



Arrangement of Aisle Light Under the Berth

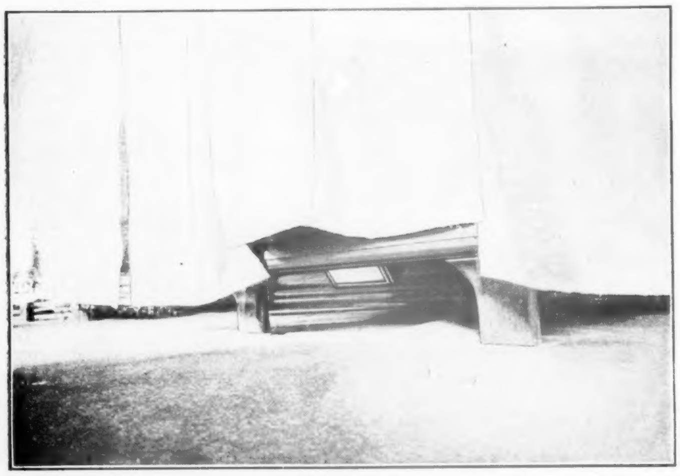
was evolved that would fulfill all the requirements. In one of the experiments a light was placed at the bulkheads at the ends of the aisles and shaded with an amber glass, with a view to providing a non-glaring light to illuminate the aisle at night. This was found to be unsatisfactory as it lighted the end sections to some extent. An attempt to secure the same results by dimming the ceiling lights also proved a failure. An installation with lights under the seat ends was tried, but the light was found to be annoying to the occupants of the lower berths opposite the fixtures. This objection has now been overcome by shading the light with a green glass.

The lighting arrangement which has been adopted for illuminating the aisles consists of 15 watt, 32 volt, type S tungsten lamps in receptacles placed under the ends of alternate seats. As the ends of the aisle are illuminated by the lights at the bulkheads it is not necessary to provide lights under the single seats in the end sections. Every second seat end on each side of the car carries one of the lighting fixtures, which are placed alternately on opposite sides of the

car. Thus a 12 compartment car has 5 aisle lights and a 16 compartment car has 7.

The aisle lights are connected to one side of the circuit which carries the current for the reading lights. By using a common return for these circuits there is a considerable saving in wire and still both sets of lights can be controlled independently at the main switchboard. Separate switches are used for the lights on the right and left sides of the car. The wires for the aisle lights are run between the inner and outer panels of the car side. Junction boxes are placed in the conduit at the seats carrying the aisle lights and short conduits are run under the seat rails to the aisle seat ends.

The fixture, which is attached to the aisle seat end and the seat rail, is pressed out of sheet steel. The base carries a small switch of the push button type which makes it possible to control each light individually. The lamp is placed in the fixture in a horizontal position, being held in place by a



Location of Aisle Light for Pullman Cars

plain Edison type socket secured by a spring clip. The casing around the light, like the base, is of pressed steel. In one side it carries a green glass which throws a subdued light over the floor. The connections are dust tight and with the exception of the green glass, which can readily be reached from the aisle, the parts will require cleaning at infrequent intervals. As will be seen from the illustrations all parts of the fixtures are easily accessible when the seats are removed and in case it becomes necessary to replace a lamp or any other part it can be done with little difficulty.

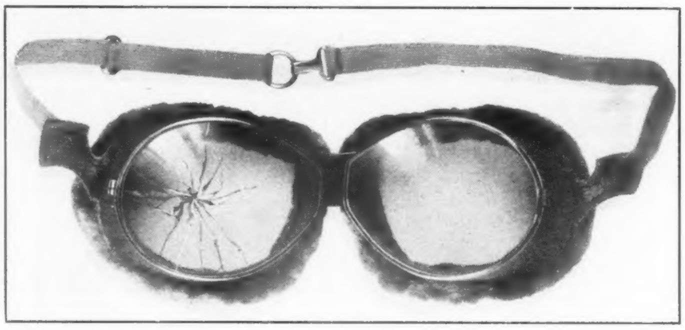
The Pullman Company is now planning to install fixtures similar to those used on the berths at the steps, to provide illumination for the treads. Clear glass, instead of green glass, will be used in these fixtures. Applications have been made by the Pullman Company for patents to cover the principal features of this system of lighting.

GOGGLES WITH NON-BREAKABLE LENSES

Safety goggles with lenses made of a new type of non-breakable glass, known as Resistal, are now being made by Strauss & Buegeleisen, 37 Warren St., New York. These goggles are adapted for use in shops and also by engineers and firemen.

The unusual properties of Resistal glass, which can be cracked but not actually broken, even by a heavy blow, are due to its unique construction. It is made up of two layers of optical glass with a layer of celluloid between, the three parts being welded into a solid mass. Even if the glass is cracked there is no tendency for it to splinter off. Unlike celluloid, Resistal cannot be scratched and is not inflammable. It is not affected by water or temperature changes. Moisture will not condense on the surfaces of these lenses and cause them to cloud up.

Goggles with the Resistal crystals can be furnished with



A New Type of Lens With Many Points of Excellence

either flat or curved lenses and in plain, amber or euphos colors. This type of glass has been used in goggles for aviators and also for military gas masks.

ASHTON MASTER PILOT GAGES

A new pressure gage of especial interest to power plant owners is being introduced, by the Ashton Valve Company, Boston, Mass.

It is designed to be hung in the center of the room, and an unusual feature is the double dial arrangement, illumi-

Double Dial Illuminated Gage

nated from the inside, which allows the pressure to be noted from a distance in either direction.

The dials, being graduated to show only 15 lb. above and below the working pressure, admit of wide divisions and large figures, so the slightest variation of pressure is noticeable and this insures close firing and economy of fuel.

NEW ROLLING STOCK FOR CHILEAN RAILWAY.—By proclamation dated September 26, 1917, the President of Chile has set aside for the use of the Arica-La Paz Railway the sum of 1,200,000 pesos ($440,000). This fund is to be used in the purchase of 100 steel freight cars of 25-tons capacity, and 3 Mallet locomotives. Persons interested may secure further information from the Ministry of Railways, Santiago, Chile.—*Commerce Report.*

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 8,100 copies were printed; that of these 8,100 copies 7,152 were mailed to regular paid subscribers, 108 were provided for counter and news companies' sales, 323 were mailed to advertisers, 162 were mailed to exchanges and correspondents, and 355 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 16,800, an average of 8,400 copies a month.

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Repeal of the Valuation Act, under which the Interstate Commerce Commission is making a valuation of railway property, is the object of a bill which has been introduced in Congress by Senator King of Utah. It is Senate bill No. 3530.

By a fire in the yards of the Boston & Maine at Boston, Mass., on January 6, 50 passenger cars, three mail cars, six freight cars and four small shops were destroyed, together with the North-Station power-plant; the estimated loss is $200,000.

The shopmen of 29 roads west of Chicago have laid before the director-general of railroads a request for better pay and for an eight-hour day; also for overtime rates for work done on Sundays and holidays. They want a maximum rate of $6 a day and a minimum of $3.50 for all shopmen, except carmen. The carmen want a maximum of $5 a day.

"The International Car and Locomotive Workers and Railway Mechanics," also called the Brotherhood of Railway Mechanics, is an organization, real or imaginary, which the Merchants' Association of New York City has investigated and has not been able to locate. Members of the association are cautioned to be certain of the facts before contributing to solicitors representing these "mechanics."

Government to Mobilize Labor

The United States Department of Labor has recently reorganized its employment service for the purpose of conducting a campaign for the mobilization of labor. This is to meet the greatly increased demand of war industries and one of the announced objects is to furnish 250,000 men for transportation service. The employment office formerly under the jurisdiction of the commissioner-general of immigration has been turned over to the United States employment service under the direction of John B. Densmore; and the Secretary of Labor has appointed a special advisory council, including representatives both of employers and of employees, with John Lind, former governor of Minnesota, as chairman. This advisory council is to direct the campaign for co-ordinating the supply and the demand of all labor.

"The labor administrator and his advisory council," says Mr. Wilson, "will at once take in hand the questions of standardization of labor policies; will consider labor dilution and training; priority demands; the adjustment of disputes and the safeguarding of employment. The advisory council will study all phases of the problem, make recommendation and plans for additional machinery and supervise their execution."

Arrangements are being made for the early transportation of 50,000 common laborers to the United States from Porto Rico. As soon as vessels are available 60,000 others will be brought from Porto Rico and the Virgin Islands, sufficient, it is hoped, to take care of the shortage in the domestic supply of railroad and agricultural workers. Director-General McAdoo has asked the employment service to assist in supplying the railroads with labor for maintenance of way and for shop work.

More Railway Honor Men

Additional data concerning the number of railroad men now with the colors have come to hand since the publication of the Railroad "Roll of Honor" appearing on page 11 of the *Railway Mechanical Engineer* for January. Returns have been received from 126 roads representing 209,463 operated miles. The number of railway officers and employees of these lines now holding commissions in the army or navy number 1,482. Of the mechanical department, W. B. Blanchford, machinist of the Baltimore & Ohio, has received a commission as captain in the regular army, and E. H. Sheeran, general foreman of the Florida East Coast, is a captain of the Railway Engineers.

Malicious Misrepresentation

Many railroad men were much surprised at a statement which was widely printed in newspapers, and which was attributed to Commissioner C. C. McChord, that: "Gross negligence of railroads under private management in giving proper care to locomotives is a principal cause of the present freight congestion." Commissioner McChord was quoted as announcing that "hundreds of locomotives which are sorely needed in the present emergency are idle in shops and roundhouses, frozen through neglect or lacking repairs which might have been made if proper forethought had been given by local railway officials."

Mr. McChord did not make such a statement. A Wash-

ington newspaper correspondent apparently drew the inference after looking over a copy of Commissioner McChord's daily congestion statement.

Buy Thrift Stamps with Liberty Bond Interest

"Apply the interest from your Liberty bonds to the purchase of government Thrift stamps." This suggestion has been advanced by President William Sproule to all officers and employees of the Southern Pacific's Pacific System. The suggestion came in the form of a circular which is to be widely distributed. Announcement is made that the company will offer the security of its own vaults to all employees who desire to protect their Liberty bonds and will collect in their behalf the interest as it accrues and either remit same or invest it in government savings stamps as the owner desires.

Locomotive and Freight Car Orders in January

The past two or three weeks have seen a sharp revival in the locomotive market but with little or no improvement in the case of freight cars.

During the month of January orders were reported for the following equipment:

	Locomotives	Freight Cars	Passenger Cars
Domestic	168	468	10
Foreign	29	6	7
Total	197	474	17

The important locomotive orders included in the 197 mentioned were as follows:

Chesapeake & Ohio	15	2-6-6-2	American
	10	0-10-0	American
Chilean State Rys	20	Mikado	American
Delaware & Hudson	20	Consolidation	American
Delaware, Lackawanna & Western	15	Mikado	American
Hocking Valley	20	2-6-6-2	American
Maine Central	8	Ten-wheel	American
Minneapolis & St. Louis	15	Mikado	American
Missouri, Kansas & Texas	25	Mikado	American
Philadelphia & Reading	15	....	Company shops
Rhodesian Rys	9	Mountain	American

Railway Regiments' Tobacco Fund

Contributors to the Railway Regiments' Tobacco Fund will be interested in a letter from Fred A. Preston, secretary and treasurer of the P. & M. Company, Chicago, now a captain in the regular army in France. He was in a hospital for a month with the measles, and after he came out he wrote a letter to Fred A. Poor, president of the P. & M. Company, in which he said:

"I had occasion while at the hospital to see what sending tobacco to the soldiers means. There were sixty privates with the measles quarantined in a separate building and they were the most cheerless lot of men I ever saw, with no clothes of their own and nothing to smoke. They were actually sick, not from measles but from pure lonesomeness. After they had been there six days the Y. M. C. A. brought around about 500 bags of Bull Durham and the whole character of the place changed in a flash. I have never seen anything which gave so much pleasure and those boys were well in an hour, and left the hospital the next day!

"There is nothing so welcome as Bull Durham with plenty of papers and matches. The latter are especially scarce. Send the tobacco in the large size bags. Before long I shall have the chance to see some of the soldiers who are receiving your tobacco. I will write you what they say; but I know now what it will be."

Further contributions have been received from the following companies:

Detroit Graphite Company, Detroit, Mich.	$3 a month for 12 months
Mt. Vernon Bridge Company, Mt. Vernon, Ohio.	10 a month for 12 months
Ohio Steel Foundry, Lima, Ohio	10 a month for 12 months

A check for $295.94 has been received from E. A. Stillman, acting chairman of the House Committee of the Machinery Club of New York, as the Railway Regiments' Tobacco Fund proportion of one-third of the net profits of the cigar department of the club, for the month of December.

MEETINGS AND CONVENTIONS

Canadian Railway Club.—A special smoker and concert will be held by the Canadian Railway Club on February 22 in the Windsor Hotel, Montreal, Que.

Air Brake Association.—The executive committee of the Air Brake Association at a recent meeting decided to hold the 1918 annual convention, the announcement stating that "Existing war conditions were finally believed by your executive committee to be a compelling force to hold a convention." The meeting will be held in Cleveland on May 7 to 10.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention May 7 to 10, Cleveland, Ohio.

American Railway Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postponed.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

Master Car Builders' Association.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention postponed.

Niagara Frontier Car Men's Association.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Feb. 12, 1918	Architecture and Building as Applied to Railway Work	C. Gordon Mitchell	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Mar. 8, 1918	Terminal Handling of Locomotives; Annual Report of Committee on Interchange Rules	Frank C. Pickard	Harry D. Vought	95 Liberty St., New York.
Cincinnati	Feb. 12, 1918	Talk on Duties of Railway Employees	Hon. Judson Harmon	H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Feb. 12, 1918	Chilled Iron Wheels	F. K. Vial	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Feb. 15, 1918	Possibilities of Reducing Effect of Moving Parts of Locomotives on Engines and Tracks	E. W. Strong	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Feb. 22, 1918	....	....	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
St. Louis	Feb. 8, 1918	....	....	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Feb. 18, 1918	....	....	Joseph W. Taylor	1112 Karpen Building, Chicago.

PERSONAL MENTION

GENERAL

JOSEPH OPIA, general foreman of the Chicago, Milwaukee & St. Paul at Austin, Minn., has been appointed general inspector, with the same headquarters.

CHARLES C. RICHARDSON, whose appointment as assistant to the superintendent of motive power of the Bessemer & Lake Erie was announced in the January issue of the *Railway Mechanical Engineer*, was born at Junction City, Kansas, on September 18, 1873. After graduating from the Greenville (Pa.) High School he became a painter's helper in May, 1890, with the Pittsburgh, Shenango & Lake Erie, now a part of the Bessemer & Lake Erie. In July, 1890, he was made a locomotive fireman, and in December, 1892, storekeeper. In January, 1893, he became a clerk, later in the same year timekeeper, and in August, 1894, chief clerk. He held this position until he was recently given charge of the office, accounting and stores department with the title of assistant to the superintendent of motive power.

C. C. Richardson

DANIEL SINCLAIR, road foreman of engines of the Northern Pacific, with office at Glendive, Mont., has been appointed fuel supervisor, with headquarters at Glendive.

J. E. BJORKHOLM, traveling engineer of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been appointed division master mechanic of the Chicago terminal, with office at Chicago.

JOSEPH BODENBERGER, traveling engineer of the Chicago, Milwaukee & St. Paul, with headquarters at Aberdeen, S. D., has been appointed division master mechanic of the Hastings and Dakota division, with the same headquarters.

L. F. COUCH has been appointed master mechanic of the Memphis, Dallas & Gulf with office at Nashville, Ark., succeeding F. J. Sears.

ALBERT J. DAVIS, whose appointment as master mechanic of the Allegheny and Bradford divisions of the Erie Railroad, with headquarters at Hornell, N. Y., was noted in these columns last month, was born at Meadville, Pa., in 1876. After leaving high school he entered the employ of the Erie Railroad as an engine wiper in 1896, subsequently serving a machinist apprenticeship. He was afterwards a machinist, erecting gang foreman and general foreman at Salamanca, N. Y., being later transferred to Hornell, N. Y., as general foreman. He was subsequently promoted to assistant master mechanic, so continuing until he was recently appointed master mechanic.

H. G. DIMMITT, district master mechanic on the River and Iowa Minnesota divisions of the Chicago, Milwaukee & St. Paul, has been appointed division master mechanic of the same divisions.

A. H. HACKFIELD has been appointed master mechanic and roadmaster of the Southwestern Railway with office at Archer City, Texas.

W. H. HART, assistant district master mechanic on the Superior division of the Chicago, Milwaukee & St. Paul, with office at Green Bay, Wis., has been promoted to division master mechanic with the same headquarters.

E. W. HARVEY has been appointed division master mechanic of the Illinois, and Racine and Southwestern division of the Chicago, Milwaukee & St. Paul, and the Rochelle & Southern line, with office at Savanna, Ill.

WILLIAM JOOST, roundhouse foreman at the Milwaukee shops of the Chicago, Milwaukee & St. Paul, has been promoted to master mechanic of the Milwaukee terminal and the Chicago and Milwaukee division, with office at Milwaukee shops, Wis.

G. P. KEMPF, district master mechanic on the Dubuque division of the Chicago, Milwaukee & St. Paul, with office at Dubuque, Iowa, has been appointed division master mechanic of the same division.

A. J. KLUMB, assistant district master mechanic of the Chicago, Milwaukee & St. Paul, with office at Milwaukee shops, has been appointed division master mechanic of the Prairie du Chien and Mineral Point division, with office at Madison, Wis.

T. S. MANCHESTER, general foreman of the Chicago, Milwaukee & St. Paul at Aberdeen, S. D., has been appointed traveling engineer, with the same headquarters.

G. J. MESSER, general car and locomotive foreman of the Chicago, Milwaukee & St. Paul, with headquarters at Minneapolis, Minn., has been appointed division master mechanic of the Sioux City and Dakota division, with headquarters at Sioux City, Iowa.

P. L. MULLEN, roundhouse foreman of the Chicago, Milwaukee & St. Paul at Sioux City, Iowa, has been appointed division master mechanic of the Southern Minnesota division, with office at Austin, Minn.

S. J. O'GAR, general car and locomotive foreman of the Chicago, Milwaukee & St. Paul, with headquarters at Ottumwa Junction, Iowa, has been appointed division master mechanic of the Kansas City division, with the same headquarters.

B. J. PEASLEY has been appointed mechanical superintendent of the St. Louis-Southwestern of Texas with office at Tyler, Tex.

M. F. SMITH, division master mechanic of the La Crosse and Wisconsin Valley division of the Chicago, Milwaukee & St. Paul, with office at Milwaukee shops, has been promoted to district master mechanic, with the same headquarters.

JOHN TURNEY, assistant district master mechanic of the Twin City terminals of the Chicago, Milwaukee & St. Paul, with office at Minneapolis, Minn., has been appointed division master mechanic of the same division.

CAR DEPARTMENT

JOSEPH BENZINGER, for many years foreman for the Chicago, Milwaukee & St. Paul at the Milwaukee shops, has retired from railroad service.

OSCAR HANDLEY, formerly with the Vandalia Railroad at Vandalia, Ill., has been transferred to East St. Louis, Ill., as car inspector for the Pennsylvania Railroad.

R. A. KLEIST has been appointed car foreman of the Baltimore & Ohio at South Chicago, Ill., succeeding E. H. Mattingly assigned to other duties.

L. K. Sillcox, mechanical engineer of the Illinois Central in charge of car work, has been appointed master car builder of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis. He was born at Germantown, Pa., on April 30, 1886, and was educated at Trinity School, New York, and the Mechanical and Electrical Institute of Brussels. He entered railway service in 1903 as an apprentice in the High Bridge shops of the New York Central, leaving there in 1906 to go with the McSherry Manufacturing Company at Middletown, Ohio. He resigned from that company as assistant shop superintendent in 1909 to become shop engineer of the Canadian Car & Foundry Company at Montreal. He left his position with the latter company in 1912 to become chief draftsman of the Canadian Northern. In 1916 he was appointed mechanical engineer of the Illinois Central in charge of car work, from which position he resigned to accept the appointment noted above.

L. K. Sillcox

William Snell, district general car foreman of the Chicago, Milwaukee & St. Paul, with headquarters at Minneapolis, Minn., has been transferred to the newly created position of the same rank at the Chicago terminal.

T. Tracey has been appointed foreman of car repairs at the East Buffalo car shops of the Erie Railroad.

SHOP AND ENGINEHOUSE

F. Armstrong has been appointed foreman of the machine shop of the Wabash at Decatur, Ill., to succeed E. J. Hausbach.

H. Eisele, general foreman of the Wabash Railway at Decatur, Ill., has been appointed shop superintendent at Decatur, succeeding William Canavan, resigned to engage in other business.

W. H. Foster, engine despatcher of the Erie Railroad at Buffalo, N. Y., has been appointed roundhouse foreman.

E. J. Hausbach, machine shop foreman of the Wabash at Decatur, Ill., has been appointed general foreman, succeeding H. Eisele.

H. Kopper, roundhouse foreman of the Erie Railroad at Buffalo, N. Y., has been appointed general foreman of the night force.

H. T. Nowell, assistant superintendent of the Billerica (Mass.) shops of the Boston & Maine, has resigned to accept a position with the New York Air Brake Company at Watertown, N. Y., as superintendent of the shell department.

PURCHASING AND STOREKEEPING

N. B. Coggins has been appointed division storekeeper of the Alabama Great Southern with office at Birmingham, Ala., succeeding D. A. Hickman, resigned to enter service of the United States Army.

A. Gerrard has been appointed material agent and assistant purchasing agent of the Missouri, Oklahoma & Gulf with office at Muskogee, Okla.

SUPPLY TRADE NOTES

P. M. Wagstaff has been appointed railroad representative for the Onondaga Steel Company, Inc., Syracuse, N. Y.

Peter L. Maher, business manager of the Eastern Car Company, Ltd., New Glasgow, Nova Scotia, has resigned his position and has returned to the United States.

S. D. Winger, formerly associated with the Prest-O-Lite Company, in charge of railroad sales, has been appointed general manager of the compressed acetylene department of the Oxweld Railway Service Company. He will be located at Chicago.

H. M. Aubrey, who has served in various capacities with the Quaker City Rubber Company and the H. W. Johns-Manville Company, has been appointed special packing representative of the Union Supply Company with headquarters at Chicago.

R. P. Lamont, president of the American Steel Foundries, with office at Chicago, has been commissioned a lieutenant-colonel by the War Department and appointed assistant chief of the procurement division of the ordnance department. He has reported to Washington for duty.

Frank Bartholomew, who has been erecting engineer for the Shaw Electric Crane Company for the past 20 years and who resigned his position with that company in December, 1917, has become associated with N. B. Payne in the Havemeyer building, 25 Church street, New York, specialist in electric cranes.

P. C. Gunion has been made advertising manager of the industrial bearings division of the Hyatt Roller Bearing Company, Newark, N. J. Mr. Gunion has been in the sales department of the Hyatt Company for two years. Just previous to his recent appointment he was manager of the Pittsburgh office.

Ralph F. Tillman has been elected vice-president of the Wine Railway Appliance Company, Toledo, Ohio, in charge of western sales with headquarters in Chicago, and W. F. Cremean has been appointed assistant to the president of the company in charge of eastern sales with headquarters in Wilkes-Barre, Pa.

P. W. Page, formerly representative for the B. F. Goodrich Rubber Company, Akron, Ohio, in western Massachusetts and southern Vermont and more recently an ensign in the United States navy, was drowned recently off the coast of England when his seaplane became unmanageable and plunged into the sea.

At the meeting of the board of directors of the Union Steel Casting Company, Pittsburgh, Pa., C. C. Smith, formerly president of the company, was elected chairman of the board of directors. J. P. Allen, formerly vice-president, was elected president. The remaining officers of the company were re-elected as follows: S. H. Church, vice-president; G. W. Eisenbeis, treasurer; W. C. Eichenlaub, secretary, and J. B. Henry, general superintendent.

Recent promotions in the Pressed Steel Car Company's organization in the Pittsburgh district made J. H. Hackenburg purchasing agent, succeeding the late H. J. Gearhart. Mr. Hackenburg was formerly the assistant purchasing agent. H. B. Fisher and C. C. Clark have been appointed assistant purchasing agents of the company. W. C. Howe, formerly in charge of the Allegheny plant, becomes assistant to the vice-president. J. C. Ritchey has been appointed electrical engineer.

R. A. Van Houten, works manager of the Sellers Manufacturing Company, Chicago, has been appointed vice-president and general manager with the same headquarters. George M. Hogan, sales agent has also been appointed assistant secretary and W. H. Seigmund, cashier, has been appointed assistant treasurer. E. M. Kerwin, secretary-treasurer, has been granted a leave of absence to enter military service, having been commissioned a captain in the ordnance department and stationed at Washington, D. C.

Charles D. Jenks, who has been the active business executive of Edwin S. Woods & Co., Chicago, has severed his connection with that concern, having been elected president and a director of the Damascus Brake Beam Company, with headquarters in Cleveland, Ohio. He was formerly in the operating and sales department of the Pressed Steel Car Company at Pittsburgh, Pa., and Chicago, and western sales manager for the Standard Coupler Company, leaving the latter concern in 1912 to go with Edwin S. Woods & Co. In his new position as president of the Damascus Brake Beam Company he will assume the active management of the operation and sales department.


C. D. Jenks

Ralph C. Davison, for the past six years associated with the American Mason Safety Tread Company, New York, in a selling and engineering capacity, has resigned his position and directorship with the above company to engage in a broader and more active field with the American Abrasive Metals Company, makers of Feralun safety treads and anti-slip surfaces. Mr. Davison, through his connection with the Concrete Association of America, has a large acquaintance among architects and contractors.

Frank W. Hall has been appointed commercial manager of the Sprague Electric Works of the General Electric Company. With the exception of a short period, Mr. Hall has been connected with the Sprague Works continuously for 22 years in various engineering and sales capacities, and for the three years prior to his present appointment occupied the position of sales manager. D. C. Durland, former executive head of the Sprague Electric Works, has resigned to become president of the Mitchell Motors Co., Inc.

Waldo H. Marshall, formerly president of the American Locomotive Company, and now associated with J. P. Morgan & Co., has been appointed assistant chief of the Division of Production of the Ordnance Department. Mr. Marshall was on the staff of Edward R. Stettinius (now surveyor general of supplies in the War Department) in the munitions department of J. P. Morgan & Co. Born in 1864, Mr. Marshall began his business life as a railroad man. He became assistant superintendent of motive power for the Chicago & North Western in 1897; was appointed superintendent of motive power for the Lake Shore & Michigan Southern in 1899; was made general superintendent of that road in 1902, and general manager in 1903, his jurisdiction extending also over the Lake Erie & Western and the Indiana, Illinois & Iowa. In 1906, he was elected president of the American Locomotive Company.

Milton Rupert was recently elected vice-president and assistant treasurer of the R. D. Nuttall Company, of Pittsburgh, Pa., manufacturers of gears, pinions and trolleys. Mr. Rupert has been with the Nuttall Company since March 4, 1893, holding various positions. In 1903 he was appointed head of the general offices, being directly in touch with all office matters and also manufacturing operations. During the latter part of this period Mr. Rupert was assistant to president and general manager. In his new position, Mr. Rupert will have charge of sales and manufacturing activities.

Charles V. Eades, who recently resigned as sales manager and engineer of the asphalt product department of the Standard Asphalt & Rubber Company, Chicago, announces the establishment of the Mineral Rubber Products Company, with offices at 280 Madison avenue, New York City. The company will handle materials and will contract for floors, waterproofing, insulation, expansion specialties, protective coatings, etc., as well as represent other well-known manufacturers. One of the special products which this company has put on the market is a moisture-proof concrete block, designed by Mr. Eades.

Guy E. Tripp, of New York, heretofore chairman of the Westinghouse Electric & Manufacturing Company, has been appointed by the War Department, with the rank of colonel, as chief of the production division of the ordnance department entrusted with the task of supervising and stimulating the production of all ordnance supplies.


Guy E. Tripp

The appointment of Mr. Tripp is one of the important steps in the reorganization of the ordnance bureau, announced recently by its chief, General Crozier.

Mr. Tripp was selected because of his experience in the manufacture of munitions of all kinds, the Westinghouse company having obtained large contracts from the British and Russian governments immediately on the outbreak of the European war. Mr. Tripp is credited with bringing to the department the highest obtainable type of experience and ability to insure speedy and careful production of munitions. The board of directors of the Westinghouse company has given him a leave of absence for the duration of the war.

Cameron C. Smith, chairman of the board of the Union Steel Casting Company, Pittsburgh, Pa., was on January 15 appointed Major Ordnance Reserve Corps, and has been assigned to the Production Department, Carriage Division of the Ordnance Department of the U. S. Army, with headquarters in Washington. Mr. Smith was born in Clinton township, Butler county, Pa., April 2, 1861. His first position was as stenographer in the office of Wilson Walker & Co., iron and steel manufacturers of Pittsburgh, Pa. He was with them ten years, during which time it was merged into the Carnegie, Phipps & Co., and then into the Carnegie Steel Company. He left the employ of the Carnegie Steel Company in 1893, and accepted a position with the Reliance Steel Casting Co., of Pittsburgh, being with them six years, when in 1899 he withdrew to organize the Union Steel Casting Company, of Pittsburgh, Pa. He was secretary and gen-

eral manager during the first year of the existence of the Union Steel Casting Company, and in 1900 was elected president, which position he has held until January 26, 1918, when he was elected chairman of the board of directors.

Frank J. Foley, formerly manager of the mining department of the Westinghouse Electric & Manufacturing Company, on January 1, became connected with the Edison Storage Battery Company, Orange, N. J., as manager of the mining and traction department, with headquarters at the main office in Orange. During the two years Mr. Foley was connected with the New York City service department of the Westinghouse Electric & Manufacturing Company, he helped install the original multiple unit control on the Brooklyn Rapid Transit system, helped install the switchboards and turbines in the Kent avenue power station of the Brooklyn Rapid Transit, and the turbo-generator unit at the Waterside station of the Consolidated Gas Company, New York. He then became connected with the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company, and after attending that company's engineering sales school for a year, was associated with the industrial sales department, going into the mining section in 1910, in which position he had occasion to handle electrical equipment for mines, including storage battery and trolley locomotives. In 1915 Mr. Foley was promoted to manager of the mining section.

W. H. Lovekin has been appointed assistant to the president of the Locomotive Feed Water Heater Company. Mr. Lovekin has been with the company since June, 1916. He was born in Philadelphia, Pa., and received his education in the public schools of that place, Haverford Preparatory School and Princeton University. He started his business career in the banking house of the Logan Trust Company, of Philadelphia. Later he accepted a position on the staff of the Bureau of Municipal Research of Philadelphia. On leaving the Bureau of Municipal Research he entered the sales department of R. J. Crozier & Co., of Philadelphia, where, because of special qualifications, he was shortly assigned to the railroad field. This position as sales representative in the railroad field brought him into intimate contact with railroad men. On June 1, 1916, he entered the service of the Locomotive Feed Water Heater Company as special representative. In this capacity he was intimately connected with the development of feed water heaters for locomotives and ships. In April of this year he was made assistant to vice-president, from which position he is now promoted.

W. H. Lovekin

Frank Fouse has been appointed works manager of the Marsh Refrigerator Service Company with office at Milwaukee, Wis. He entered the service of the Pennsylvania in 1888. From 1896 to 1901 he was with the Pressed Steel Car Company at Pittsburgh, Pa.; from 1901 to 1908 with the Pittsburgh Testing Laboratory, and in the latter year he entered the service of the United Fruit Company as general foreman of the car department at Costa Rica.

CATALOGUES

BELT PULLEYS.—The American Pulley Company, Philadelphia, Pa., has recently published an instructive booklet on "Getting Maximum Pulley Efficiency." It contains an explanation of the power losses due to belt slip and a comparison of various pulley tests. The advantages of split steel pulley construction are plainly indicated.

SMOOTH-ON SPECIALTIES.—A new edition of the instruction book published by the Smooth-On Manufacturing Company, Jersey City, N. J., has recently been issued for free distribution. In addition to information regarding the use of Smooth-On iron cement, the booklet contains a list of the standard sizes of Smooth-On coated corrugated gaskets for flanged pipes of sizes from 2 in. to 26 in.

LATHE AND DRILL CHUCKS.—The Skinner Chuck Company, New Britain, Conn., has issued a very complete catalogue and price list of their products. All kinds of independent, universal and combination chucks are illustrated and the price for each different size is given. Planer chucks with either a square or swivel base and several different styles of drill chucks are also shown.

DIRECT CURRENT DYNAMOS.—The second of a series of catalogues of industrial motors has just been distributed by the Westinghouse Electric and Manufacturing Company of East Pittsburgh, Pa. This is known as Catalogue 30 and covers the company's complete line of direct current motors and generators for industrial service. After giving considerable general information regarding the ordering, classification and selection of direct current motors the catalogue shows the rating and dimensions of different types of motors used in reversing planer equipment, machine head stock equipment and arc welding motor generator sets.

ELECTRIC WELDING OUTFITS.—An interesting booklet on Electric Welding has been recently issued by the Wilson Welder & Metals Company, New York City. It is carefully arranged and contains in detail the development of the Wilson system in the electric welding field. A complete illustration and description of the apparatus is given and the advantages of independent control and constant temperatures are pointed out. Emphasis is also laid on the importance of the metal used in welding, and the claim is made that tests on electric welded joints in boiler steel plate show an efficiency of 100 per cent. The back of the book contains some useful tables and information and is valuable for reference.

BAKELITE MICARTA-D GEARS AND PINIONS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued a booklet describing the material and the methods of using Bakelite Micarta-D gears and pinions. Bakelite Micarta-D is a non-metallic material made up of a special heavy duck of uniform weave, thickness and tensile strength, bonded together with Bakelite by heating under very heavy pressure. The material is developed for use where silent operation is desirable and it is especially valuable because of the fact that it is not affected by water or oil, or by most acid or alkali solutions. The booklet gives a complete description of the properties of the material, the methods of working it, a complete outline of the methods of designing the gears and considerable data for the use of gear designers. The booklet is thoroughly illustrated with drawings and photographs and copies may be obtained upon request to the company's nearest branch office.